

The Socio-technical Production of GIS Knowledges:

The Discursive Construction of Bodies and
Machines at Scottish Natural Heritage

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PhD Thesis

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December, 1998



I declare that this thesis represents my own work, and that where the work of others has been used it has been duly acknowledged.

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1st December, 1998

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Acknowledgements

I am indebted to my supervisors: Liz Bondi and Gillian Rose, whose advice, encouragement and vision has been invaluable. Gillian has been involved in this project since its conception, and has kindly followed it through by providing comments on this thesis, despite being officially on leave. I am especially grateful to Liz, who ‘inherited’ this project in its final year. William Mackaness, my second supervisor, provided useful comments on drafts from his perspective as a GIS practitioner, and was also extremely helpful in using his contacts to set up the empirical study.

I would like to acknowledge the staff at Scottish Natural Heritage, who agreed to be interviewed for this research, and Stuart Gardener, my SNH contact, who acted as liason between SNH and myself.

This research was funded by the ESRC.

Abstract

This thesis focuses on the situated use of Geographic Information Systems (GIS) in one government organisation - Scottish Natural Heritage (SNH) - in order to explore the mutually productive and complex relationships between the social and the technical. The account is located within science and technology studies (STS) and feminist theories, both of which challenge notions of technical determinism and the neutrality of science and technology, suggesting instead that technological artefacts are products of complementary and competing discourses, and their limits. These theories, which are reviewed in Chapter One, are utilised to illustrate that GIS is a boundary object that is co-constructed as an object of knowledge and as a technological artefact through the messy nexus of social relations in which it is practised, whilst it concurrently actively contributes to the production of the social. In-depth interviews were conducted with staff who had recently been trained to use GIS as part of a major GIS implementation strategy in SNH. The methodology is described in Chapter Two. The interview transcripts were subjected to discourse analysis, in order to explore how the practice of GIS co-constructs fluid technologies, bodies and subject positions, which gain only the appearance of stability through their iterative citation in discursive practice. The empirical data are explored in three substantive chapters. Chapter Three examines the discourses which enable GIS, through the operation of power, to (re)produce particular geographies. Drawing on theories of the visual, it is argued that GIS, as a technology of realist representation, relies not merely on discourses of rationality, but also on its own inexplicability, which enables it to function as a site of spectacle and magic. Chapter Four focuses on the GIS user, exploring the practice of GIS as a site for the multiple production of bodies and subject positions. Haraway's figure of the cyborg is utilised to explore how users relate their bodies to the machine, and three possible subjectivities are proposed: the magician, the apprentice and the inept. The final substantive chapter explores how GIS emerges through the agency of both users and the machine itself, as they negotiate each other. It is argued that through these complex situated negotiations GIS is multiply embodied and constructed as a sentient other. The thesis concludes by examining the relevance of feminist geography to an understanding of these processes.

Chapter One

Science, Technology and Other Tall Tales

1.1 Introduction

This research investigates the processes through which computing technologies and their users negotiate each other, and how these negotiations contribute both to the practice of technology, and to the construction of users and the technologies they use. Current debates in social theory have destabilised the notion of technology as an autonomous force that merely represents the application of the most advanced scientific knowledge. Instead, theorists situate the development and use of technology within social processes, suggesting that our technologies are both a product and constituent of the social (Webster 1991, Law 1991, Cockburn and Ormrod 1993). Computing technologies, interwoven and constitutive of systems of meaning and signification, emerge from this analysis as fluid objects, which gain only the appearance of stability through their repeated and routinised use. They are formed through the material practices of collectives of actors, from designers to users, and open to continuous negotiation as both technologies and situated actors attempt to establish and stabilise their meaning (Hinchliffe 1996). It is this (re)productive relationship with the discursive that gives meaning and form to both technologies and users, as they are co-constructed through their interaction with one another.

This research focuses on one computing technology: Geographic Information Systems (GIS). GIS includes hardware and software that captures, manages, analyses and displays specific types of spatially referenced data. Although GIS incorporates a range of different products marketed by different vendors, which vary in their technical design, GIS basically operates as follows. Spatial data, in the form of points, lines and areas, are captured through a digitising board, or other electronic

data capture devices, such as remote sensing or Global Positioning Systems (GPS). The attribute data related to them are entered, for example, through a keyboard and stored in a Relational Database Management System (RDBMS). The GIS provides a range of functionality that allows spatial relationships between the data to be explored, such as the overlaying of two themes, adjacency of different features and area calculations. Finally, the GIS incorporates a range of output functionality, enabling charts, graphs and maps to be displayed on the screen, or sent to a printer or plotter.¹

GIS is considered an appropriate choice of technology to study for two reasons. Firstly, it provides a case study of how one technology interacts with the discursive. Focusing on a single technology allows it to be analysed in greater detail, enabling its impact to be more fully explored, whilst such insights may also have implications for how other technologies are understood, and how they might be researched. Secondly, GIS' emphasis on, and approach to, managing spatial data is unique, and as a technology which has considerable influence on society, it is an important object of study in itself. GIS has continued to grow significantly as an area of interest within geography, while concurrently it is increasingly being adopted by commercial and public sector organisations. A number of factors have led to its broadening use and appeal among a diverse range of users, such as improved interface design and cheaper/more powerful computers, coupled with rapid data capture/abstraction technology (incorporating the use of GPS). The depiction of space, mediated by the technical structure of GIS, thus informs a growing body of academic research, in addition to commercial and public decision making. This includes a diverse range of applications, from its use by government bodies to inform environmental decision making or transport policy, to its use by insurance companies to target potential customers or determine pricing bands for policies for cars or homes. This suggests that there is a need to consider how GIS, unique in its depiction of space, is understood and negotiated by users.

¹ For a very straight-forward, fuller explanation of the technical configuration of GIS, see Martin (1991).

Given their increasing utilisation in academic, private and public sector environments, together with their increasing complexity, there has been a growing awareness, amongst both practitioners and critics of this technology, of the role of the user in the design, implementation and practice of systems, as well as growing interest in the importance of cultural, social and political factors in both their design and use (Eason 1993, Buchanan 1993). In addition to emerging interest in the social, ethical and political implications of this technology (Miller 1992, Lake 1993, Pickles 1995a, Gilbert 1995), increasing attention is being paid to GIS as a new mode of expression. Such research recognises that GIS constitutes more than a 'geographical tool' which merely performs tasks more efficiently than traditional manual methods, instead suggesting that it represents a new means of describing geographical phenomena. GIS thus implies a change in the relationship between the user and the 'worlds' that he or she is endeavouring to describe, explain or interact with (Veregin 1995). This suggests that GIS must be understood as a technology which exists, develops and is utilised within a social setting.

Such notions are consistent with feminist and other social studies of science, in which this research is contextualised (Wajcman 1991, Haraway 1991, Webster 1991, Cockburn and Ormrod 1993, Hinchliffe 1996). Such studies argue that it is technical factors, such as feasibility, *together* with social influences, which dynamically interact to influence both technology and its place within society. GIS emerges from such theoretical understandings as an 'actor' technology situated on a social stage. This approach to understanding GIS provides a challenge to those that view it as a neutral technology, which, depicting a transparent, singular 'reality', only requires increasing technical sophistication to represent 'real-world' data more efficiently, more flexibly and more completely (Wright et. al. 1997). Instead, it situates GIS within the complex nexus of social relationships, through which it is negotiated. Drawing on postmodernist and feminist debates, which have challenged the universalistic framework of geographical and other scientific knowledges by arguing that a vision of singular reality is only plausible from the universalising perspective of the Master, this thesis will explore the discursive structures through

which ‘GIS knowledge’ is created and in which its methodologies are situated (Keller 1985, Bordo 1986, Bondi and Domosh 1992). Such a position suggests that GIS has never constituted an objective medium, as the knowledge and experience of users, together with the structure of the GIS, gives context and relevance to the whole notion of information, and to understandings of GIS itself.

Star and Griesemer (1989) usefully invoke the concept of a boundary object to avoid the problems of applying rigid definitions to technological artefacts. The notion of a boundary object articulates the processes through which the same artefact is variously interpreted by different social groups, constructing artefacts which lack rigid definition, but are marked by boundaries where different interpretations coincide and conflict. Star (quoted in Haraway 1997: 297) suggests that such boundary objects do not exist outside their social context, but:

“arise over time from durable co-operation between communities of practice, as working arrangements which resolve anomalies of naturalisation, without imposing a naturalisation from one community or from outside”.

As these “anomalies of naturalisation”, that is the differences between discursively structured accounts of an artefact suggested by different groups, are resolved, the technology connects multiple perspectives. This suggests that technology emerges from its use, where it is subject to continuous negotiation between the situated actors and artefacts who attempt to stabilise its meaning. The notion that boundary objects do not pre-exist, but are forged through their social genesis does not suggest that technologies are purely a product of their discursive interpretation, as it does not discount the ability of technologies to resist or limit how they are understood. However, by insisting that artefacts cannot be known outside the discursive, it provides a useful strategy for situating technologies within their social and technological contexts, rather than perceiving them as a product of pure science or technical expediency. The notion of boundary objects has been adopted by social theorists for a range of different artefacts, such as Haraway’s (1997) work on genes and Harvey and Chrisman’s (1998) work on GIS, illustrating the flexibility and wide applicability of this concept.

Harvey and Chrisman (1998) reject the assertion supported in much of the technical literature on GIS that this technology can be understood as a tool, which exists independently of its interpretation (Wright et. al. 1997). Instead, they draw on the work of social critics of GIS and theorists from the Science and Technology Studies (STS) school, such as Latour (1987), Curry (1994) and Sheppard (1995), to support the contention that each GIS is a unique construction, that is (re)produced through its situated practice. They suggest that GIS comprises not only the material software and hardware, but the people, working practices and organisations associated with its application.² This provides a more flexible interpretation of GIS, which moves beyond the purely technical description outlined above, enabling a definition of GIS which is sensitive to the complexities of its practice. The GIS emerges from this understanding as a boundary object, articulated through complex socio-technical relations, where locally contingent social processes construct a different GIS every time (Harvey and Chrisman 1998).

Haraway (1997: 268), acknowledging the importance of boundary objects as a useful theoretical device, suggests that it provides one strategy for avoiding the “fallacy of misplaced concreteness”. She is referring to the dangers of assuming a tangible and singular reality, a fallacy that has provided the basis for Western Scientific discourses, which assert that truth can be derived from empirical observation. Haraway suggests that to produce a situated subject who can view science, forge links and see from other places, feminism needs such strategies: it requires a “modest witness”. Such a witness, possessing the vantage point of non-standard positions, might question how scientific knowledge is produced and sustained. Haraway contends that this witness, interrogating critical silences, unpacking why certain questions are never asked, and uncovering disavowal in the essence of what is presented as neutral or rational, is pivotal to feminist approaches to science. This thesis, situated within these debates, is an attempt to view GIS from

² As failed implementations have focused attention on organisational issues, this notion is beginning to gain currency within the technical literature on GIS. However, despite increasing attention to social context, this literature has not embraced the notion of GIS as socially constituted.

a position outside of the dominant scientific discourses, which structure currently pervasive understandings of it.

Haraway (1997) identifies a number of inter-related strategies adopted by feminists to produce such a subject position: Harding's standpoint theory, her own cyborgs and situated knowledges, and the body of work that has unveiled science as a social construction, and technology as socially shaped. These strategies contextualise the understandings of GIS advanced in this thesis, and will be reviewed in the following sections of this chapter. For drawing on the work of Haraway and other social theorists, these theoretical devices provide a basis for exploring how discourses of Western Science and technology have structured the position of GIS. In the second section, critiques of science and technology, which have challenged scientific claim to uncontaminated truth are reviewed, prior to outlining feminist revisionist projects, which have attempted to provide both other vantage points from which to understand science, and alternative scientific practices. Actor Network Theory (ANT) is explored as a strategy, which asserts the agency of artefacts as well as humans, and provides a means of richly mapping the socio-technical relations in which GIS is situated. This section concludes by examining Cyberfeminism as a practical revisionist project, which has attempted to both analyse the relations between gender and technology, and to pursue a liberatory agenda. Section three examines social constructionist case studies of computing technologies, which provide insights into how the practice of technology is both a constituent of, and active in the (re)production of the social, as technology is utilised in situated contexts. Finally, section four focuses on the role of the body in producing subjectivities as users interact with technology. This research will thus draw on these current debates in an attempt to determine how GIS, in its use, constructs both practice and users, and is itself (re)produced through these interactions.

1.2 Critiques of Science, Technology and GIS

Both feminist and postmodernist theories have been critical of the universalising framework adopted by science, which claims to reveal truths which transcend the perspective of any one human being or group (Keller 1985, Star 1991,

Nicholson 1990, Rose 1993, Bondi and Domosh 1992, Latour 1987). They argue that the claim to a pure or neutral position renders the scientific method the most 'naturalised' of all Western knowledges. This section explores this critique, and its relation to technology and GIS, before outlining the revisionist projects that this criticism has prompted. The work of Latour (1987) is pivotal to recent theorising of scientific discourse. He argues that truth is constructed through negotiations of the principles, concepts and artefacts that connect different groups, and thus the process by which a fact is accepted as truth is a social one, which is dependent on rhetoric. Rhetoric is defined as the tactics employed to make a knowledge claim plausible. These include a variety of strategies, such as enlisting the support of powerful 'friends' by referring to former texts, or fortifying articles with graphics and tables, so that layers of detail anticipate reader's objections, whilst also substantiating the article's arguments.

Latour refers to this process as the First Principle, where the construction of fact is a collective process, for "when things are true they hold (and) when things hold they start becoming true" (1987: 31). Identifying these processes initiates a distinction between negative and positive modalities. Negative modalities are statements in which the conditions of their production are embedded, that is, they are legitimated by explicit reference to the processes through which they were arrived at. When a negative modality is accepted as true, it is presented as a statement of fact, which is beyond question. This could be illustrated by considering the example of using GIS to establish whether a proposed road would have an effect on a local wildlife population. A negative modality might state: 'The analysis of survey data using GIS suggests that the proposed road would have a detrimental effect on wildlife'. A positive modality would erase the conditions of production, and the statement would be presented as fact: 'the proposed road would have a detrimental effect on wildlife'. In this sense, science creates a series of 'black boxes': socially situated arguments, which when accepted as fact, are rendered transportable through the social network. Such a view of science defies its self-styled vision of neutrality, re-imagining it as a set of social practices, which are both situated within, and

actively contributing towards discourse. Science can thus no longer occupy a position of epistemological or ontological privilege, for within these social constructionist frameworks, it is no longer possible to claim a neutral perspective, and both science and Nature itself become contested terrains (Young 1992).

Science has attracted interest from feminist theorists, who argue that it fundamentally underpins and legitimates male dominance. Rejecting the plausibility of knowledge which transcends the knower, feminists have argued that philosophies of Western Science are based on a dualistic model, where the cultured Masculine is defined in opposition to the irrational, to Nature and to Woman (Lloyd 1984, Merchant 1980, Bordo 1986, Longhurst 1997). They argue that Western Science relies on separation of the bounded subject from the object of study, and of the rational mind from the passionate body. Bordo (1986) describes this process as a masculine birth, where the separation of the child from the mother is mirrored by the adult severance of the rational autonomy of the mind from the passions of the body. This separation is structured through binary opposites between knower and known, subject and object, culture and nature, objectivity and subjectivity, and man and woman, where only the first term is allowed to define itself, as 'a' while the universal qualifier, not 'a' defines the Other. Thus man is written as objective, rational and ultimately neutral, while the feminine is in part constructed by the process of its exclusion, becoming a repository for what rational knowledge transcends or leaves behind.

Science is thus both reliant on, and active in the (re)production of, social relations and the social meaning of gender (Fee 1986). Situated within structures of patriarchy, feminists argue that science is a powerful ideology which is exploited to legitimate and rationalise a range of social, economic and political 'strategies', from racism and sexism, to war and competition (Star 1991). These strategies are enabled by 'positive modalities', which promote practices that consolidate the positions of the powerful by presenting their claims as the inevitable outcome of truth, rather than as the assertions of situated individuals. Science, for example, was historically used to suggest that the marginalisation of ethnic peoples was justified by their genetic

difference to white Westerners, while, more recently, different scientific arguments have been used to support the current dominant construct of equality (Haraway 1997). This illustrates the ability of science to adapt in order to support dominant positions, maintaining the legitimacy of both science and the practices which arise from it.

Recognising these processes, feminist geographers have questioned the basis of geographic science as universal, neutral, objective, unproblematically communicable, and singularly true (Bondi and Domosh 1992, Rose 1993). Less familiar to debates within geography however, is the growing movement within science studies and sociology to deconstruct the boundaries between science and technology, and ultimately to dissolve or soften the rigidity of this border. It has been argued that science has attempted to disassociate itself from technology, reserving uncontaminated purity for itself, whilst bequeathing the dirty, hands-on, ethically contentious elements to technology (Wajcman 1991, Winner 1985). Latour's (1987) term *technoscience* is an active attempt to challenge this division, defining technology as the embodiment of science. Rejecting the pure/applied dualism, science is stripped of the justification previously afforded by the notion that it is objective and rational, and instead is perceived as a collection of powerful ideologies and practices transforming the social landscape. Runstrom (1995) adopts the concept of technoscience, for example, to explore the racist assumptions of GIS, whilst Singleton (1995) applies it to a feminist analysis of cervical screening. The commonality between these diverse examples is the discovery and deconstruction of black boxes, and their implications. For rather than perceiving technology as the application of an ethically pure science, which has merely provided users with the 'best' available technology which progress can offer, it fundamentally brings into question that which is accepted as *fact*; examining instead, the means by which a *fact* becomes constructed as truth (or not).

Studies of technoscience are complemented, and historically grounded, in the sociology of technology, which has called into question the notion of technology as asocial, non-political and progressive (Webster 1991, Winner 1985, Mackenzie and

Wajcman 1985). The emphasis here has been on deconstructing technology itself as a social product, challenging notions of technical determinism, which view technologies as the ‘natural’ or inevitable result of the most advanced scientific knowledge. These theorists have also cogently contested discourses of progressive historical change, which suggest that developments in technology are inherently progressive, as each new technology incorporates increasingly sophisticated scientific knowledge. Such debate has however been peripheral to geography and its technologies, and has only emerged significantly in social critiques of GIS (Smith 1992, Pickles 1995a, Curry 1995a).³ These critiques, which reject the notion that the technology is either objective or neutral, have criticised both its methodology and practice, situating it instead within discursive and social structures. These criticisms include dissatisfaction with the practice of GIS: Runstrom (1995), for example, contends that GIS has been used to protect the interests of Westerners in land management at the expense of indigenous people, while Crampton (1995) is critical of intrusive marketing practices that adversely impact the interests of particular disadvantaged groups. At another level, the methodology of GIS has been criticised as inherently unethical: Curry (1995a, 1995b), for example, argues that the GIS establishes relationships between people and data which are problematic, regardless of the intentions of the practitioners.

Military applications of GIS have attracted particular criticism, and provide an example of how the structure of GIS supports particular truth claims.⁴ The technology, with its association with military surveillance and ‘smart’ weaponry, profoundly shaped social understandings of the 1991 Gulf War, and had material effects on the course of events. This war, described by Smith (1992: 257) as “the first GIS war”, was supported by GIS technology, which provided a vision of the world as closed, interconnected and controllable, mobilising and (re)producing a

³This is not intended to discount the small number of other recent studies within geography, which have attempted to explore spatial and social relationship created through the utilisation of technologies, such as Massey’s (1995) study of High Tech Science Parks and Hinchliffe’s (1996) study of electricity.

⁴ Although it is the structure of GIS inherently supporting truth claims that are the focus of attention here, clearly many social theorists would also object to the practice of GIS for military purposes (Smith 1992).

narrative of a singular globe, one world only escapable by moving into space (Edwards 1995). Computers had a key role in producing the United States as a global manager, representing precision, control, rationality and surveillance. In combination with totalising views of global and small area data, the distance provided between combatant and target by GIS smart weaponry provided a simultaneously detached and intimate view (Roberts and Schien 1995, Veregin 1995). The technology was thus able to present a clinical and sanitised view of the conflict, which enabled the war to be presented in a favourable light to the Western viewer. The emphasis on the surgical precision of the procedure, for example, suggested that only 'proper' targets could suffer. The surveillance technology of Western Civilisation was endowed with perfect vision, while the Iraqi were portrayed as hiding and devious. Thus when the US military hit an air raid shelter killing hundreds of civilians, the US insisted that they had attacked a 'legitimate' target, and Saddam Hussein had deliberately sought to invalidate the Allied data by purposefully endangering Iraqi civilians (Robins and Levidow 1995). Social theorists of GIS are not suggesting that the technology imposes specific outcomes, or even necessarily different ones, but they insist on its ability to fundamentally rewrite the relationships between those actors implicated in the action, generating an array of subject positions, from those who kill, to those who die, to those 'voyeurs' who watch from technically produced external vantage points.

Social constructionist theory challenges the deterministic view of technology by arguing that 'technical discoveries' are a reflection of their discursive context, while they also produce the social, as technology opens some social options, whilst excluding others (MacKenzie and Wajcman 1985, Dobres 1995). Certainly this view has been adopted by social critics of GIS, who have sought to re-imagine such systems as the product of particular social conditions, while they also contend that GIS have enabled particular views of space, which reshape human experience of the world, even if the technology is not considered to be prescriptive in terms of that experience (Pickles 1995a, Sheppard 1995). The reliance on Cartesian space and maps within GIS, for example, can be seen as a product of Western discursive

understandings of space - an understanding which may be contrary to those outside this position, such as indigenous peoples (Runstrom 1995). In turn GIS promotes the use of maps, which constrains the type of analysis and outcomes producable, thereby influencing what is deemed possible, and ultimately contributing to the production of discourses (Pickles 1995a, Veregin 1995).

Although critiques of GIS within geography have drawn attention to the social dimension, they have largely ignored issues of gender. This appears to be a grave omission, particularly as social constructionists within sociology and STS have theorised gender, in addition to other social identifiers, such as race and class, as being crucial to an understanding of technology. This partly stems from the assertions of social constructionists that the (re)production of gender and technology, like the establishment of scientific principles, are intimately related, so technologies of war, for example, are not merely influenced in their construction by gendered behaviour, but that they actively construct versions of masculinity and femininity in themselves. Consider the above example of the Gulf War: Wheelwright (1992) asserts that the military actively pursued a policy to present a largely male image of war, rendering heroic the efforts of male aircraft pilots. This was achieved by both exaggerating the dangers to Allied pilots, while playing down the heroism of female (and male) 'support' staff. The US and UK armies still do not allow women to hold combatant positions; however the distinctions between non-combatants and front line soldiers are contestable. In the US Navy for example, women are not allowed to serve on aircraft carriers, but do work on the tankers that refuel them.⁵ This distinction between male and female soldiers has in effect allowed the contributions of women to be written out of history, while it also denies women access to the technology and to the promotional opportunities afforded by 'active' service (Wajcman 1991). In this sense the technology is actively constructing both images of war, of technology and of gender. Masculinity becomes embedded in the 'successful' smart weaponry operated by smart men, and the technology feeds on,

⁵ Similarly, in WW2 British anti-aircraft batteries were manned by male combat soldiers firing guns, while female non-combat personnel worked beside them providing target, loading and search light services.

and feeds into the notion of war as a largely masculine affair where women may only participate as victim (refugee, widow, rape victim.....) or helper (nurse, cook, factory worker....). War consumes and masculinises the technology, and the technology is constructed through its utilisation in war, contributing towards both what it means to be a soldier, and what it means to be a man.

1.2.1 Revisionist Projects

Feminist theorists have adopted a variety of approaches to analyse the relationships between gender, technology and society, as a basis for formulating revisionist projects. At one extreme these encompass overtly essentialist positions, which suggest that technology is inherently masculine, and destructive to both women and the environment (Sim and Hensman 1994). These perspectives tend to vilify technology as detrimental in itself, and suggest that women are better served by rejecting technology altogether. Such an approach is however marginal to the dominant social constructionist schools of thought. These feminists, insisting on the social construction of technology as a basis for reading science and its technologies as a malleable script with the inherent possibility for change, have campaigned for 'better' or successor technology and science⁶ (Harding 1991, Rose, H. 1994). The centrality of discourse is well established in social constructionist and postmodernist accounts of gender, science and technology (Haraway 1992, Law 1991, Keller 1992). The contention is that such categories are not naively given, but in part structured by various discourses which dynamically interact through power to produce truth and knowledge (Driver 1985). The notion of discourse, based on the work of Foucault, rejects the possibility of a naively given 'real world', suggesting instead that shared understandings emerge from the operation of power, which (re)produces the ideologies that structure systems of belief. In this sense, traditional history is understood as the production of a plausible lineage which is exploited to support current belief systems. Pervasive discourses, from technical determinism to notions

⁶ Campaigning against funds being directed into military research has been especially central to feminist attempts to remould a 'better' science, some feminists arguing that the distribution of funds is over-biased towards military projects, at the expense of more constructive projects (Rose, H. 1994).

of masculinity, emerge from this analysis as a product of the operation of power, rather than truth per se (Foucault 1977).

Feminist scientists have argued that the discourses surrounding both technical and biological determinism function to maintain male dominance in Western society. The common assumption that gender is determined by biology, and that science is derived from nature, legitimates oppression of both women and the natural environment by grounding male supremacy in empirically observed 'fact'. Keller (1992) argues that the construction of gender and science is so intimately related it is often difficult to envisage the impact of one upon the other, for if gender is neither biological nor cultural, but what culture makes of biology, and science is not *natural*, but rather what culture makes of nature (where gender is a significant component of such culture); both concepts are irrevocably embedded in one other.

This is considerably complicated by the problematisation of gender as a category. Early feminist critiques of science, which were based on the assumption that there were two genders and one science, often disputed the notion that women were different from men, and therefore less able to engage with science, while subsequent analysis has recognised the masculinist nature of science's universal norm. As discussed above, objectivity and rationality have been constructed in Western Scientific discourse as inherently masculine, where the feminine is by definition excluded from scientific practice. Feminist response to the masculinist nature of science has been divided between radical constructionist and critical empiricist approaches, which differ substantially in their conceptualisation of gender. Critical empiricism or standpoint theory embraces a revisionist project, where women occupy a privileged position, which affords them the ability to produce less partial and less distorted beliefs, that is, a *better* science (Harding 1986, Harding 1991, Rose, H 1994). They argue that this is because women are less implicated in dominant patriarchal structures, and are therefore less likely to produce knowledges biased by the dominant discourses. Radical constructionists, most notably Haraway (1988), have queried the status and nature or theorising itself, suggesting that whilst

knowledge is the product of discourse, feminist theory can never uncover universal truths (Haraway 1985, Haraway 1988, Flax 1987), while Woman herself emerges as a socially constructed category. Haraway has proposed situated knowledge as an alternative, where embodiment and partiality become the basis for rationality. Such partial, locatable, critical knowledge suggests that all wisdom is not equally valid, but that no knowledge is final.

Both radical constructionists and standpoint feminists therefore recognise the need for knowledge to be embodied, whilst committing to a revisionist view of science (Hekman 1990). Their emphasis on the position of Woman is however markedly different. Standpoint theorists position women as a discernible minority rights group; radical constructionists emphasise that the category of Woman is socially constructed. This is a subtle and important difference, which reflects dilemmas surrounding the status of Woman in feminist theory, for while feminism is centrally concerned with Woman, the retreat from universalism suggests that she should be read as a masculinist social construct. This does not mean that there is no commonality between those embodied individuals who have been named as, and have experiences as, 'women', since acknowledging gender as a discursive representation does not imply it has no material effects. For the feminist project however, this understanding of the category, Woman, can be seen to form a paradox, as feminism must both reject and rely on Woman, in that it simultaneously provides a point of resistance against patriarchy and a symbol of affinity (Butler 1990b, Modleski 1991, Weigman 1994, Gatens 1996). An understanding of technology and science therefore requires a careful reading of the discursive production of Woman, which is complexly produced through multiple discourses. Thus technology and gender act to (re)produce each other, and Woman, contributing to the construction of technology, is concurrently produced by technology and science, as well as through other diverse, contradictory and complementary discourses, including its own deconstruction, that is, through feminism itself (De Lauretis 1989).

In effect such deconstructive self-reflexivity has created a crisis of meaning in modern theory, which has troubled standpoint theorists, such as Sandra Harding

(1991). She argues that cultural or epistemological relativism is a potentially dangerous path for women, who presently occupy a weak position in society, and who cannot seek a redistribution of power by severing the connection between *truth* and *knowledge*, particularly if powerful technoscience continues to rely on and maintain this connection. A good example of her fear proving founded might be Grassie's (1996) paper on science and religion, who quoting the debate between Haraway and Harding at length, comes abruptly to the conclusion that Haraway's situated knowledge "opens the door to religions as critical components to any epistemology of nature or culture" (1996: 288) - which would be outwith the remit, and, given the patriarchal structure of some religions, possibly discordant with many feminist revisionist projects. Similarly feminist sociologists and geographers have viewed cynically the coincidence of women gaining political and analytical voice, at the same time that theory has moved towards epistemological pluralism (Bondi 1990, Bondi and Domosh 1992, Law 1991). Certainly a theory of situated knowledge is open to both misuse and misinterpretation. However, the need to locate feminist theory between standpoint theory, with its reliance on a relatively monolithic Woman, and postmodernism's worse excesses of deconstructive relativism, is strong. There is a need to develop a position which neither relies on an essentialised Woman, who occupies a privileged position, or the notion that there is no reasonable basis for deciding between competing knowledge claims (Harding 1991). Importantly such dilemmas are illustrative of the embedded nature of discourses, and of the myriad of relationships between the production of discourse and the discursive product. That is, that which is produced by discourse, be it science, gender or technology, cannot be perceived as a stable given, but exists continuously in a state of flux, where the products of discourse continuously interact and evolve together. So those objects which are produced by discourse continue to resonate in the production of new discourses.

Such complexity demands a careful approach to technology. A feminist revisionist project cannot reduce everything to infinite complexity and embeddedness and continue to act as an effective basis for change (Haraway 1991). However, the

need to recognise this complexity arguably demands an approach which is both stable and fluid (Berg and Lie 1995). Thus, for example, technology and the social can be considered as separate interacting entities, whilst simultaneously acknowledging the discursively constructed nature of the boundaries between them. It is this demand for subtlety that has led Grint and Woolgar (1995) to criticise the social constructionist school of analysis' view of technology, which suggests that artefacts are structured *solely* through their social genesis. The danger in an emphasis on social process is that it can serve to exaggerate the importance of socio-political context.

The notion that social forces shape technology, if not carefully stated, can be read as suggesting that objects are neutral prior to social influences. Clearly artefacts cannot exist outside the social. This is not an ontological claim, but merely reflects the embedded nature of discourse, for ultimately it is impossible to imagine an artefact outside its discursive meaning, that is outside our discursively formed understanding of it. Although it is clear that technology cannot be convincingly portrayed as the application of discovery, it is equally unconvincing that technology is entirely the result of socio-political context. Grint and Woolgar (1995) assert that such suggestion merely banishes technical determinism, in favour of social determinism. For analysis which views technology as moulded by the social is susceptible to perceiving the social, and that which is considered to be a component of it, such as gender, as rigid and coherent, and ultimately stable. Gender has been a key variable explored by feminist social constructionists, who have often sought to argue that specific technologies are gendered. At worst such can produce an essentialising perspective: Benston's (1988) claim for example, that technology is masculine and doesn't support the things that women want to say, fails to even consider who these groups called 'women' and 'men' are. She uncritically assumes homogeneity and coherence within the two genders, and differences between them. This does not mean that certain technologies do not have particular effects for 'women', but to ask whether an artefact is 'male' or 'female' is misleading. This privileges gender as stable, where as in fact all these categories are discursively

constructed, interacting and fluid. The pertinent question therefore becomes how do different discourses interact with each other, and with what effects?

Such qualification is key to an understanding of the production of technology, for it views it as a product of a number of competing, complementary and contradictory discourses, none of which are stable or necessarily internally consistent. That is, various products of discourse continuously interact in specific historical and spatial contexts to (re)produce themselves, and other discourses. Given the complexity of this process, various discourses may therefore overlap or contradict each other, thus rendering them simultaneously mutually constructing *and* mutually disrupting. The complexity of this process gives rise to very specific meanings, which make rash generalisations dangerous, for clearly the effect of discourse can attribute very different meanings to the same artefact or activity. The image of the computer hacker, for example, can appear simultaneously masculine and emasculated. The hacker geek, popularised by Turkle's (1984) influential study of computer scientists at MIT, can be seen as the epitome of deviant, unmasculine behaviour. Turkle's description of them as nerdie, unwashed, slightly built, sunken faced, dishevelled young men, who disappear into their computers to escape social and sexual interaction, contrasts sharply with the socially and sexually active, physically fit and dashing figure of hegemonic masculinity. However, the hacker lifestyle can equally be interpreted as exploiting differing discourses of masculinities, for example, constructing hacker masculinity from the image of the maverick, who heroically dares to be different and defines himself through his mastery of the machine (Håpnes and Sørensen 1995). The malleability of artefacts within discourse is however not infinite, but constrained by the limits of discourse itself, as the materiality of the artefact limits the range of interpretations that can be imposed upon it.

1.2.2 Actor Network Theory

Actor Network Theory (ANT) provides one strategy for mapping the messy relationships between technologies and the social. It is based on the work of Callon,

Latour, Haraway and other theorists writing in the field of STS, including, more recently, geographers (Callon 1991, Latour 1993, Haraway 1991, 1997, Thrift 1996). ANT attempts to embrace the complexity of technologies and their productive relationship with the social by emphasising how human actors and technological artefacts combine in situated social contexts to form complex actor networks. This perspective is fully relational in that it is concerned with the multitudes of actors and artefacts, including bodies, technologies, texts and social practices which are associated to produce and sustain order through contingent networks. This theory is useful because it enables technologies to be considered within their social context. Rather than perceiving an artefact as a stable given, it is considered a boundary object, which comes into being through its social genesis. In this sense, agency is a relational process, where technologies and actors have contingent and disparate effects, which are dependent on the specific actor network in which they arise (Thrift 1996, Graham 1998).

Tracing the connections between technologies and actors is a complex process, as it attempts to uncover relations which are both technical and social, and contextually dependent. It assumes that there is not a single instance of a technology, and thus GIS is (re)produced within a complex nexus of social relations, which create a different GIS every time (Harvey and Chrisman 1998). This perspective contends that it is the apparent homogeneity of a technology that is the 'real' illusion, which obscures the new forms of social interaction which are constantly being created through situated practice. ANT is of particular relevance to this project, because it articulates the relationships between the multiple spaces, bodies and practices created through GIS through messy contextual mapping, providing a means of plotting the connections between GIS, its practice and its users, whilst avoiding the dangers of overly essentialising socio-technical relations. It recognises the embedded nature of discourse, and it formulates the arbitrary distinctions between technologies, bodies and discourses as an attempt to illuminate their integration.

Mobilising the concept of boundary objects and messy contextualised connections, ANT disputes the boundaries between machines and people. This focus

on socio-technical hybrids makes explicit the difficulties of separating the social from the technical, whilst illuminating the multiple and contingent social realities that are achieved through, and in conjunction with, complex technical artefacts. Haraway (1988, 1992, 1997) contributes significantly to this debate in her attempts to soften the sharp divide between active constructing subjects and passive constructed objects. Breaching the division between constructionist and realist philosophies, she asserts that although discourse is important to the development of artefacts, artefacts are never entirely malleable to discursive interpretation. That is, objects take on their own agency, limiting the ability of discourse to interpret them, and the excess of representation remains outside discourse as a potential site of instability. The relationship between discourse and its limits have been conceptualised by Haraway as a symbolic conversation struck up between subject and object. Thus within such a theoretical understanding, gender, for example, could be read as neither entirely cultural or biological, but as a product of the relation between the two. In this context, the concept of Woman can be understood as constructed through discourse, without discarding female biology and its influence, and the body becomes more than just a screen onto which discourse is projected, but becomes dense, capable of both resistance and disruption (Haraway 1989, Young 1992, Birke 1994). Haraway (1992) adopts the term ‘material-semiotic actor’ to describe the object of knowledge as one which is active in its own production. Such analysis maintains the tensions between reading artefacts as texts, and their ability to resist, for this interpretation offers agency to the objectified, providing a community of meaning, where “the world neither speaks for itself nor disappears in favour of a master decoder” (Haraway 1988: 593). Such argument applies neatly to technology, where social constructionists have sometimes seemed to imply that technology is purely a product of social will, rather than technological expediency or material possibility.

Certainly computers could be described as material-semiotic actors, which limit the ability of both users and designers in how they are interpreted. Woolgar (1991) attempts to re-envisage the power dynamics between computers and their users by suggesting that the production of new computer products also involves the

construction of the user. In this sense both the machine and user have limited agency. The developers prescribe a range of possible interactions, and thus while the user has a degree of flexibility in that they can put the technology to uses that the designers couldn't envisage, equally the machine can also develop its own agency by going 'wrong', that is, displaying functionality which wasn't intended. Such a vision of computers tends to disrupt notions of clearly bounded entities, which can be ascribed cognitive or passive status, while this positioning provides a critical vantage point from which artefacts may be conceived differently (Woolgar 1991). Arguably the disturbance around this boundary provides a point of resistance. In particular the attribution of agency to technology provides a basis for merging the human with the technical (to create the cyborg persona), but it is also suggestive of an oppositional space between technology and how it is imagined. It becomes apparent that technology cannot be perceived as entirely a product of discourse, but must be understood as simultaneously embedded in discourse and resisting the ability of discourse to interpret it.

1.2.3 Cyberfeminism

The notion that technologies are constituent of, and active in the production of the social has prompted some feminist theorists to move beyond earlier analysis which tended to vilify technology as complicit with patriarchy (for example, Rothschild 1983, Benston 1988). Rejecting the claim that technologies inherently support traditional gender roles, subsequent analysis has moved beyond this critique, questioning instead what is meant by technology and gender, in an attempt to unravel or unpack the relationship between gender identities and the machine. Situating technology within its discursive production, such studies have blurred the boundaries made distinct by masculinist philosophy. This process began as feminists started to voice tentative dissatisfaction with the extent to which *feminine technologies* have hardly been considered technologies at all (Wajcman 1991, Cockburn and Ormrod 1993). They argue that technologies such as washing machines, food mixers and typewriters have been aligned with the feminine, while objects such as household drills, wrenches and welding machines have been constructed as masculine. This

dualism functions to invest status in gaining competency in male technologies, while female technologies are perceived as being easy to use. Dissatisfied with women's exclusion from the status afforded by 'masculine technologies', some feminist practitioners and theorists of technology have developed this critical perspective into a proactive challenge to masculinist control of technology.

Feminist calls for women to seize control of technology have attempted to provoke an active re-imagining of both technologies and women by adopting a strategy which challenges both male domination of the technology, in terms of male involvement as designers and users, and the notion that technology is essentially masculinist. Most feminists have rejected deterministic arguments about new technologies increasing opportunities for women, such as the lessening need for muscle power to operate computers stimulating female use; however some feminists have argued that technology provides a dynamic environment which can be used to re-present women, rather than merely to re-enforce their image as victim - one figure which many feminists consider dominates the present technological landscape (Deakin 1984, Lie 1995, Kirkup 1992). Particularly within the field of computer related technologies, this position has been promoted by a number of feminists who self-identify as Cyberfeminists, though they are sometimes known as Techno-fems or Power-feminists. Jennifer Light's (1995) paper in *Gender, Place and Culture* is possibly the first unequivocally feminist cyber-geography. However the growing presence of 'Techno-fems' in other disciplines, influenced by theorists such as Donna Haraway, Sandy Stone and Sadie Plant, is apparent, especially on the WWW (World Wide Web), while increasingly this perspective is gaining currency in both popular magazines and academics publications. Light's argument can be read as a call to other feminists and women to re-appropriate computer mediated space, engaging in the "creative act of re-envisioning its users" (1995: 133). She argues that engendering new uses de-genders the machine, giving women the opportunity to deny their subordinate status, in that women using computing technologies disrupt both notions of hegemonic femininity and the discourses surrounding technology.

In initiating this revisionist project, Cyberfeminism treads a careful line between its intention to prompt women to seize control, and the dangers of essentialising the very embodied individuals it seeks to liberate. Thus Light is eager to suggest that cyberspace provides a powerful, flexible space, allowing different visions for different women.⁷ Some Techno-fems, not content with enlisting the support of women, have attempted to forge a ‘perverse alliance’ between women and machines, arguing that both are coming alive and disloyal at the same time. It is perhaps strategically dangerous to promote such a link, for if machines and women are both gaining agency, it is certainly agency of different kinds (Steffensen 1996). For even if artefacts can be acknowledged as active in their own (re)production, their position is socially and politically distinct from sentient actors. Despite this, Cyberfeminism never-the-less holds the promise that women and technology might be creating new subject positions from which to imagine each other.

Cyberfeminism, with its emphasis on seizing control of the technology, implies a far less rigid conceptualisation of both gender and technology. For although it is accepted that technology is designed and used in gendered contexts, both gender and technology are considered as “simultaneously negotiated and constructed” (Berg and Lie 1995: 347). Haraway (1992) adopts the term *co-construction* to describe the processes by which artefacts come into being through the situated effects of numerous actors, both organic and non-organic. Although Haraway is concerned in this instance with the construction of Nature, this concept can be applied to the mutual (re)production of technological artefacts and their users, which situated in social contexts act to continuously (re)produce each other through rich actor networks. This implies that continuous and complex constructions leaves artefacts, like discourses, in a state of flux, promoting fragmentation and inconsistency, as different supporting and conflicting discourses interact. Feminists have argued that in environments of rapid change, as provided by technological innovation, the scope for destabilising gender is enhanced (McDowell and Court

⁷ Light (1995) however has little to say about how cyberspace is more accessible to women who are educated, technically competent, English speaking etc..

1994), yet it also follows that the fluidity of gender roles can destabilise technology. The telephone is perhaps the most often quoted example of this: originally envisaged as a business tool for men, telephone companies initially frowned upon women's adoption of the telephone for personal and social use, before recognising its commercial potential (Rakow 1988). Similarly, although typewriters were initially marketed at men, the number of female typists quickly surpassed their male counterparts, as women recognised that typing provided a source of employment outside of the home (Davies 1988).

The co-construction of technology and gender suggest that although artefacts cannot be considered outside their socio-historical context, neither can they be considered as rigid, self-contained or stable. Håpnes and Sørensen's (1995) study of male hackers, mentioned above, provides a good example of this complexity. They used an ethnographic approach to study Swedish hackers, analysing how their identity was produced through their interpretations of their computers and themselves. Disagreeing with Turkle and Papert's (1990) sharp divide between analytical (male) and artistic (female) approaches to programming, they argued that hackerdom was a complex culture, associated with co-operation and collaboration, as well as with competition, directed at both the computer and other hackers. Swedish hacker culture is thus rendered ambiguous, for depending on both control and artistry, it draws on a variety of conflicting discourses associated with masculinity and femininity. This suggests that the computer promotes the construction and re-interpretation of traditional male values, so that hacker identity is related to (and contributing to) the construction of masculinities, but not determined by it.

1.3 The Practice of Technology

The situated impact of computing technologies in specific workplaces is aptly illustrated by recent studies by Lie (1995), Sundin (1995a) and Hughes (1996), which all attempt to unravel the tensions between gender and technology. These studies constitute examples of the limited empirical work undertaken on how gender processes impact the practice of computing technologies in workplaces, and will be

reviewed in this section to illustrate the situated use of technology. They achieve this by examining the impact of computers in different workplaces, including cartographic drafting offices, solicitors and sales companies. The common theme in these papers is that gender identities are continuously negotiated, while technical objects can function variously as visible symbols of hegemonic and other masculinities. The construction of artefacts as symbols is dependent on a number of factors, and although computers were used to perform a range of functions in the various offices, it becomes clear through these studies that differently positioned workers can construct differing visions of the same artefact, depending on their situated perspective. These accounts are related here partially to illustrate how technologies impact on, and are articulated through the complex social worlds in which they are utilised, and partially to situate the accounts of GIS explored in thesis. These case studies exemplify how technologies as boundary objects are devices which produce situated meanings, which lack stability and resist attempts at generalisation.

Sundin's (1995a) analysis of the introduction of Computer Assisted Drafting (CAD) systems to two workplaces provides a good example of this. Although the workplaces were very similar in terms of the type of work being done and the gender structure of the work force prior to the introduction of CAD, very different outcomes ensued. The CAD system tended to conflate two jobs; engineers, traditionally men, and cartographers, traditionally women. However, in one workplace the men took on the new combined CAD role, while in the other workplace it was the women. Sundin argues that this is because in the latter workplace, masculinity was initially invested in images of fieldwork, which was mainly undertaken by the male engineers. When CAD was introduced the men perceived it as a feminine drafting tool, which was the concern of the women. As time passed, the women became faster at drafting, creating a bottleneck, which was solved by the management by training women to undertake field work tasks. Within the company, women remained the most skilled CAD operators, and their position thus became secure in the new working practices.

The introduction of CAD to this work place has direct parallels with the commercial adoption of other technologies, which have also affected the gendered pattern of employment. In insurance sales, for example, women, who traditionally had not been employed in this sector, represented nearly half of the work force by 1991 (Hughes 1996). This is arguably a direct effect of the introduction of automated computing packages, which require traditionally female VDU input skills, rather than expertise in the insurance market (Hughes 1996). However, these processes, by which technologies affect the gender composition of the work force, are always locally contingent: at the other workplace in Sundin's study, CAD had been perceived as a decision making tool from the start, and the engineers were reluctant to allow the female cartographers to use it. Thus as the engineers undertook more of their own drafting, the cartographers became redundant. This suggests that the social context in which technologies are implemented affects how they are understood (Sundin 1995a, Sundin 1995b). As a boundary object, understandings of the technology are negotiated through its use, disrupting the impact of technologies in shaping the social itself. This creates a symbiotic and complex relationship, where the technologies are both constituent of, and active in the production of discursive structures and social relations.

Both Lie (1995) and Hughes (1996) also found attitudes to computers were dependant on the situated position of the user. Lie's study involved interviewing managers and workers in a large service company which sold agricultural components. She found that the relationship to the computer depended upon gender and the hegemonic masculinities which different groups of men relied on. So managers, for example, were more likely to enthuse about the centrality of the computer to their work, experiencing it as "corresponding to their position as leader, as a means for overview, decision making and increasing one's own capacity" (Lie 1995: 387). In contrast the salesmen, who were often recruited for their mechanical knowledge rather than their academic background, were more likely to dismiss the computer as unimportant, suggesting it was a female domain, even though they would often reveal they were dependent upon it for certain functions. Lie argues that

this is because their intimate understanding of (agricultural) machines did not extend to the computer, which they viewed as a closed box. It thus became so remote as a machine to them, that they tended to view it as (feminised) office equipment.

Hughes (1996) argues that gendered interpretations of technology are responsible for the uneven reshaping of gendered tasks in both the insurance and legal sectors. She suggests that as computers become more central to many professionals, who are using them to manage their schedules, prepare documents and communicate via email, typing is no longer associated with low status work. Familiar with the computer, and perceiving it as a high technology tool, professionals such as lawyers and business managers, do not feel emasculated by typing their own papers. Concurrently she notes resistance to this, particularly by senior managers, where the desire for a secretary has become even more intimately bound to status. These examples are suggestive of the tensions, which arise in the process of co-construction. The way in which the technologies were exploited in these scenarios was dependent upon situated understandings of hegemonic masculinity and femininity, through which users developed notions of self and gender identity, and on their understandings and utilisation of the technology. The multiplicity of meaning which can be derived from gender relations is thus productive in constructing multiple gender/technology relations, providing multiple options as actors negotiate their positions (Ormrod 1995). In this sense the flexibility of the technology allows computers to operate at different functional and symbolic levels, so that the impact of a technology on an organisation is dependent on the socio-technical production of knowledges through which that technology is articulated.

1.4 Bodies

Feminist theorists of technology, asserting that technologies are fluid, unstable and produced through their iterative practice and citation in discourse, have also questioned the status of the body. As discussed in section 1.2, Western Science relies on a number of binary separations between subjective/objective, feminine/masculine, mind/body. The separation of the mind from the body has been

pivotal to the truth claims of science. Rendering knowledge a “correspondence between rational minds and intelligible forms”, it depends upon the “assumption that pure intellect cannot distort reality” (Lloyd 1984: 11). Such masculinist science therefore presents itself precisely as disembodied, where the rational mind anchors its truth claims in its separation from a passionate, feminised body (Keller 1985, Haraway 1985, Longhurst 1997). Convincingly critiquing the plausibility of this separation, as discussed in section 1.2.1, feminists have insisted on the necessity of embodied, situated knowledge, and of a more careful account of the relationship between the body and technology (Haraway 1988, Bell 1994).

Understandings of the body in masculinist science are however marked by a contradiction, for while such science relies upon the rationality of the disembodied mind, its truth claims are also supported by theories of one science and two sexes, which anchor the will for truth in the notion of a singular body. An understanding of the male subject as contained and coherent, embraced by a bounded, impermeable body, has been exploited in masculinist reason to support the concept of a neutral, coherent and objective *Man of Reason*. Feminists, arguing instead that technologies, bodies and discourses (re)produce themselves and each other as multiple, fluid and unstable, have resisted the concept of both the unitary self and the male and female sexed bodies (Ferguson 1989, Fraser and Nicholson 1990, Probyn 1993). The bounded masculinist body has been attacked by feminists as a discursively situated method of social control, which produces a manageable and trackable form of identity (Lloyd 1984, Fuss 1990, Stone 1996, Steffensen 1996). That is, the notion of the singular subject is supported by the single corporeal form, anchoring the individual in their body. The body has also been recognised by feminists as crucial in the writing of gender identity, because it serves as a visible symbol of the subject, where “stable gender identity is predicated on the stability of the body itself” (Hendershot 1992: 373). The corporeal body provides a visible phallus which supports the concept of the two sex model that has dominated modern thinking since the late eighteenth century. The notion that the phallus or its absence denotes gender

absolutely obscures the notion that gender identity is discursively produced (Creed 1995).

Such a conception of the body stems largely from the work of Michel Foucault, and of subsequent feminist theorists. This theory rejects the notion of any naturalised, non-historical or organic body - a concept which has underpinned Western reasoning since the Enlightenment - arguing instead that the body cannot be known outside its cultural meaning (Cream 1995, Rose 1995b). Foucault suggests that the body should be viewed as a cultural and historical construction, which both contributes to, and stems from the exercise of power. Foucault establishes the body as a malleable resource, which, subject to continuous deformation, is created in particular forms exactly so that it may legitimise specific regimes of domination (Foucault 1977, McNay 1992). Although Foucault's arguments have not been accepted uncritically by all feminists, they have been embraced by some, who argue that his conceptualisation of the body allows the influence of the bodily to be explored without relying on essentialist or biological notions of the body, while it also provides opportunities for disrupting the binary dualisms characteristic of Western thought surrounding the body (Bell 1993, McNay 1992, Butler 1990b, 1993, Rose 1995b). Importantly, severing the link between the 'natural' and the body has provided a space within feminist debate to explore how the control of the female form is used to construct femininity (and control women) by confusing gender identity with biological truth. These arguments have also been adopted by Cyberfeminists to explore the arbitrarily constructed nature of the machine/human border. Rejecting the modernist notion that only bodies [people] produce technologies, Cyberfeminism asserts that technologies are producing bodies too: the boundary between the body and technology has thus been acknowledged as a terrain of mutual construction (Stone 1995c).

Sandy Stone's (1991a) analysis of trans-gender surgery provides one example of how technologies might be producing bodies. Such invasive surgery has obvious material effects on the patient, but Stone's interest lies in the discourses surrounding such surgery, arguing that it is not the surgeon's knife that transforms the male form

into the female, but the assumption that gender can be inscribed into that flesh. She details how clinicians examine prospective patients for ‘appropriate’ gendered behaviour, while success is considered to entail transforming an unhappy man into a fulfilled woman (or vice-a-versa), with no intermediary space. Struggling to be accepted both for surgery, and by society, transsexuals struggle to behave ‘appropriately’, and long to pass as members of their chosen sex, implying that while their bodies become a screen on which they project provisional and discursively structured notions of gender, the clinic becomes a “technology of inscription” (Stone 1991a: 294). In this sense, transsexuals are constructing bodies, both through the surgery on their material body and by projecting an ‘appropriate’ bodily image.

Stone extends and supports this argument with her study of the phone sex industry. She suggests that although these practices are markedly different, utilising technologies which are politically, socially and technically distinct, both activities produce the body by “coding cultural expectations as tokens of meaning” (1991b: 102). In phone sex, workers translate complex sets of behaviour into a single sense modality, or highly compressed tokens, which are then reconstructed by the customer on the other end of the line. This means that the phone sex worker can use a cultural token, such as ‘luscious lips’ or ‘long legs’ to signify a desirable woman. The desire arises from the tension between the token and the embodied reality. Phone sex is thus no more than data compression, where the workers are producing and selling the body, albeit not a material one (Stone 1995b). Stone’s work throws into sharp relief Foucault’s notion that bodies, far from being natural, are social products, but it also highlights the way in which technologies might be instrumental in creating bodies. For accepting Foucault’s assertion that bodies are made, it seems reasonable to suggest that technologies could be providing new ways of becoming embodied (Marsden 1996).

Abandoning the notion that bodies are naturally given opens up a theoretical space in which to examine how technologies build bodies, for as social artefacts they suggest some options, whilst limiting others. In this sense, as technologies are invented, so are bodies (Chapman 1994). A computer program, for example,

embodies assumptions not only about how it might be used, but about those who will use it, and thus as the product is configured, so is the user. Technology therefore constructs assumptions and practices about machines *and* people. As Langdon Winner (1994) suggests, for a MacDonalds cash register this might be: 'the system is intelligent, its users are not'. The production of bodies can therefore be envisaged as a dialogue between technologies, bodies, discourses and their limit. The boundary between the body and technology is a point of mutual construction. Bodies are always present, and thus the subject and the body are never severed, even if the body in question is not always the material one.

It has been argued by some feminists that the dissolution of this boundary has potential for women, because in acknowledging that technology can invade the impermeable body, it disrupts a traditional site of male power, contesting a boundary from which women have historically wrought little benefit (Steffensen 1996). A distinct machine/human border, and its connotations surrounding the sanctity of life, have traditionally been applied to male bodies, championing the rights of man over machines, animals, nature and women. This border is one that men have been addressing, notably through the masculine genre of Cyberpunk fiction.⁸ Cyberpunk narratives claim to explore the destabilising impact of new technology on traditional social and cultural spaces, (including the body).

Pile (1994) adopts this genre to sketch the effect of geographical technologies on society in his Commentary in *Environment and Planning A*. Writing in diary form, he situates himself in a mythic future, and thus adopts the classic Cyberpunk device of viewing the present from a critical distance. The Cyberpunk genre provides an interesting framework from which to consider geographic technologies. In Pile's fictional account, the act of doing geography is equated with inhabiting a cyberbody or avatar and entering cyberspace, which is conceptualised as a network of data, which the avatar can travel within. Thus it is only when Pile (1994: 1815) has finally received his hardware and software from the "inefficient" supplier that he

⁸ Although Cyberpunk writers are mostly men, there are a number of feminist writers who have adopted the Cyberpunk genre in some of their writing, such as Marge Piercy and Anne McCraffrey.

can eventually declare: "I am now a geographer". Although understanding data as a space which an embodied form might occupy is characteristic of the Cyberpunk genre, Pile's attempt to apply this understanding to geographic technologies is novel, and provides a new perspective from which they might be imagined. His strategy also provides a challenge to the traditional writing styles typical of academic journals, providing the fictional character he adopts for himself with the flexibility to celebrate an image of the future, one without qualitative methods, where geography is governed by the military. Clearly, given Pile's other writing, this is an ironic stance, which is vividly produced as a nightmare vision through this technique.

Pile's account therefore constitutes an interesting textual strategy, which enables him to integrate the body into geographic technologies; however these tactics also illustrate the danger inherent to this approach. By collapsing the difference between an imagined future and current real in order to critique the present, Pile seems unaware that like much of this genre, he is embracing the same, peculiarly masculine, strategy of totalising vision that he appears to be attempting to critique in GIS. The technique of using the future as a vantage point to gaze at the present produces an authoritative narrative which privileges Pile's account. His depiction of our current real is presented as established 'truth', as Pile, or Pile's fictional character, judges the validity of current knowledge claims on the basis of what occurred subsequently, which he suggests either proves a claim or not. "Openshaw could not have known at the time...." contends Pile (1994: 1815), but these flourishes are neither situated or embodied: his vantage point, pervasive as it may be, is literally from nowhere. Adopting the classic Cyberpunk heroic character for himself, he transforms the figure of the geographer into that of an cybernetically enhanced adventurer, who transverses the dangerous terrain of cyberspace, which is littered with mortal enemies. Pile would doubtless claim that he is adopting the genre as an ironic device; however one cannot help but wonder if he is enjoying the role of masculinist hero too much. In this commentary Pile seems to conflate a quantitative GIS with cybergeography, dismissing other images and analyses of Cyberspace as well as qualitative geography, which he declares "unscientific rubbish" (1994: 1818).

Although this reflects his 'ironic' stance, the irony doesn't succeed, as it writes them out of the text and out of existence. This textual strategy does not challenge existing power relations, and Pile succeeds only in creating a masculinised text: the medium is different, the message is the same, and in this case, there is really very little message at all. This commentary is suggestive of the ways in which the masculine can use such boundaries to explore its own uncertainties and emerge stronger. Cyberpunk has hardly embraced feminist projects. The stock hero, the resisting white guy or maverick, is often not a position open to women and other minorities, whose resistance has traditionally been written as pathological (Ross 1991, Wahl 1993). This suggests that dissolving the boundary between the body and technology isn't necessarily a radical move.

If the creation of the body is recognised as process, this raises a whole series of issues as to how this process is negotiated. Foucault (1977) argues the body is produced through the exercise of power; however it must be noted that he conceived power as positive and productive, rather than repressive. Distinguishing power from force, he argued that power is what holds over subjects who are free to choose. Thus modern power is manifested through discipline, that is through surveillance, rather than the punishments characteristic of Sovereign Rule. This suggests that in modern society force becomes less necessary, as the construction of normative modes of behaviour leads individuals to strive towards conformity. Foucault argued that this occurs under the threat of real or imagined surveillance. In this sense individuals must identify with dominant modes of thought if they are to assume personal feelings of self-determinacy. Certainly such arguments seem to apply to Stone's study of trans-sexual surgery, where both clinicians and patients seek to construct a body marked by societal norms. The creation of such conforming, self-policing *docile bodies*, provides an efficient means of control, since the oppressed both contribute and 'approve' their own subordination (Deveaux 1994).

The tendency towards normalising modes of behaviour has been recognised by feminists exploring the construction of bodies in cyberspace. McRae (1995), for example, argues that the possibilities created by virtual environments are freedoms

which are rarely explored, precisely because of the tendency towards conventional models of gendered behaviour. Thus in Multi User Domains (MUDs),⁹ where users can define their own body, choosing options which do not necessarily match their biological flesh, stereotypical images, such as leggy blondes and muscle bound men, are prolific. In this sense the virtual environment provides a more conforming, normalised or idealised population of bodies than can be found in the material realm itself, and thus, rather than being a space of exciting possibility, it becomes “nothing more than the verification of the normative processes” that produce gender in the first place, even though the specific behaviour of individuals might be unusual (McRae 1995). A biological man assuming a female persona in cyberspace, for example, is perhaps experiencing an extraordinary position; however anecdotal evidence that suggests such swaps are common, or go undetected, merely enforces the notion that fixed gender behaviour does not exist, and that embodied individuals are able to perform the genders they have chosen. Choosing from the limited range of performances culturally on offer, the body emerges from its citation in discourse, which through constant re-iteration provide the illusion of corporeal stability. This supports the notion that bodies, not being natural, are produced through performances, which are enhanced, constrained and mediated by the technologies through which they are articulated.

Perhaps the most corporeal form of subjectivity to evolve in intersection between body, discourse and technology debates is that of Haraway’s (1985) cyborg. Recognising that the technology/body interface has been mobilised in masculinist discourses to solidify the discursively constructed distinction between manufactured artefacts and natural organisms, Haraway proposed the cyborg as one possible challenge to this dichotomy. Asserting that both notions of the bodily and the technological mediate human experience of the world, cyborgs provide a multitude of monstrous hybrids who *can* be differently situated, for they blur the boundaries at

⁹ A MUD is a computer application which creates a virtual environment, that enables multiple users to log in and interact with each other in real time.

which the body starts and ends (Whatmore 1997). This provides a basis from which to radically re-imagine technology as a agent which:

“shapes our perceptions and cognitive processes, mediates our relationships with objects of the material and physical world and our relationships with our own and other bodies” (De Lauretis 1989: 56).

The cyborg was intended by Haraway as an ironic political myth, to disrupt the sacred boundaries between machine and body, which she argues are themselves breaking down. Haraway’s intention was to exploit this instability as a catalyst for social change, stimulating new uses of the body. The body from this perspective is more than just an organic body, and more than just a screen onto which cultural fantasies are projected as in MUDs or Cyberpunk fiction (Steffensen 1996). Instead, cyborg monsters have a potential to provide an alternative realm of possibility from the fictions of Man and Woman, for the amalgamation of machine and organism is suggestive of a new notion of self, where the concept of being human can no longer be taken for granted (Wolmark 1993). Haraway (1995) suggests that she was influenced in her choice of the cyborg from Marge Piercy’s novel *Body of Glass*.¹⁰ Perhaps this is because Haraway and Piercy’s vision is of a cyborg that writes itself, that may develop its own agency. For where the boundaries between what is human and what is object are blurred, the notion of unitary identities, and of agency, is destabilised.

Haraway (1992: 298) proposes that bodies should be perceived as “material-semiotic generative nodes” because their boundaries materialise in social interaction. Such a notion goes beyond social constructionist interpretations of the body, for rather than implying the body is a biological object whose representation and functioning is political and constructed, it suggests that the body itself cannot pre-exist. That is, it exists only as (or through) its status as a site of contestation (Grosz 1994). Equally however such a conception of the body allows for its inventive and multiple creation, for such flexibility allows there to be a disjuncture between lived bodily boundaries and the borders of the material body (Marsden 1996, Poster 1990).

¹⁰ Published as *He, She and It* in the US, the story unfolds the growing awareness of the cyborg man Yod, who finally refuses his pre-destiny as weapon, and develops his own morals and agency (Piercy 1991).

The notion that bodies can be constructed, for example, as cyborgs or virtual selves, has led some feminists to adopt multiplicity as a point of departure, for if embodiment becomes a process clearly this provides the opportunity for the active creation of bodies.

Turkle (1995) concludes from her studies of the internet that the ability of the user to become author of both text and self, allows for the construction of multiple parallel bodies, where the boundaries of each are fuzzy, and the self is fractured. Yet such theory implies that the production of bodies is experienced cumulatively, and that each body is discrete and perfectly formed. That is, Turkle's description suggests that each 'incarnation' can be created, stored and known, while she offers little explanation as to how these multiple facets interact to produce the fractured self. The notion of multiple, parallel bodies also echoes uncomfortably with the rather mechanistic concept of parts and wholes. Instead, the process of (re)producing the body might be better described as metabolic, where the body, through a continuous process of self-constitution, exists in a constant state of flux. Such seems consistent with the notion of performance that Butler (1990b) advocates, where performance becomes an iterative act, constantly reaffirming meaning and power, though never being certain of reproducing the same thing. In this sense the body becomes a resource for the operation of power, burdened with the need to signify; heavy with signification. And if the body, as Rose (forthcoming) suggests "actually means nothing at all", equally it also always means something.

This suggests that in computing technologies embodiment emerges through performing the body. The centrality of the body serves to constantly influence technology and discourse. So in cyberspace, users take deliberate measures to construct bodies for themselves and others. Correll's (1995) study of a lesbian on-line cafe, for example, details how socialising in this cyberspace is performed as a bodily experience, where cafe dwellers drink coffee or alcohol depending on the time of day, sit in their favourite chairs, and leave together to have sex. Technologies therefore become a means through which the bodily is negotiated and articulated, and as bodies can never be entirely malleable, they become instrumental in the

production of technologies. The user becomes author of both text and self, and where the self is constructed through the interaction of bodies and technologies, the boundaries of each are messy (Turkle 1995). Thus the phone sex worker constructs a body which may not relate to her own, or the computer user adopts one bodily position within computer mediated space, while their material body is left at edge of the interface. In this sense bodies, technologies and discourses becomes mutually co-constructing, where discursively situated, discursively limited bodies, are produced through discourses of technology and their limits, and where technology is partially the product of bodies.

The suggestion that bodies are culturally produced through performance does not imply that they lack materiality, and indeed it is Foucault's lack of attention to this, that has attracted criticism from feminist commentators. They argue that his over-emphasis on the cultural interpretation of the body has tended to disregard women's lived bodily experiences. Although the whole notion of resistance in Foucauldian philosophy has been of concern to feminists, it has also been suggested that Foucault gives the impression that the material body offers no material resistance (McNay 1992, Bordo 1993b). Cyberfeminists have also been concerned by this growing tendency to shed the material form, as though the 'meat' can be left behind as the disembodied rational mind enters cyberspace. That is, technology is presented as if it renders the body entirely malleable, open to any technically feasible construction. For in an age of technology, of virtual reality, cyberspace, genetic engineering and cosmetic surgery, the material seems to get in the way, and get put out of the way, and Cyberspace becomes the ultimate phallic fantasy, where the mind apparently *replaces* the body, leaving the material body in suspended animation (Penny 1994, Morse 1994). Clearly however the body is not so easily silenced: as the users sits at her terminal, her back aches, her eyes grow tired, she hungers and thirsts. The fingers at the keyboard are not so distant from that virtually constructed flesh, for the embodied experience of that programmer or modeller or user is fundamental to their creative construction of their virtual bodies, whether those bodies are virtual personas for themselves as they engage in cybernetic interaction

with the computer or other virtual bodies, or whether those bodies are the multitude they construct as they make up a GIS database. For although technology can mediate embodiment, it does not create bodies which are not anchored to material forms, be it through the aching back of the operator, or the influence of lived experience, for lived bodily boundaries form part of an intensive corporeal schema.

Van der Ploeg and van Wingerden (1995) cogently argue that it is this tendency to ignore the materiality of bodies which is indicative of a dangerous trend within some feminist writings of the cyborg, in which the radical boundary between machine and human has been dissolved, so that the cyborg is no longer a dialogue between man and machine, but a technological construct of infinite possibility. The tendency to negate the human body jars uncomfortably with Haraway's (1985) original vision. Although her "Cyborg Manifesto" was an attempt to disrupt understandings of the body as organic good, as expounded by some eco-feminists and strategic essentialists who have vilified technology, her intention was not to discard the flesh, but to embrace the fuzzy machine/human boundary. The cyborg as a radical subject position is undoubtedly important as a site from which to develop new critical questions; however without rejecting the centrality of this construct in feminist analysis of technology, it is possible to recognise the dangers inherent in its structure. The existence of the cyborg depends on disrupting the boundaries between body and machine, but inevitably it also stabilises these categories, supporting the dualism it purports to breach. Perhaps more seriously, the pervasive adoption of the cyborg figure, which is itself a symbol of union rather than difference, has left the cyborg entrenched as seemingly the only subject position available to feminists and women in relation to technology, despite attracting criticism as an image that reflects the conquest of the imperfect feminised flesh by the efficient masculinised machine (Van der Ploeg and van Wingerden 1995). The suggestion here is that the body, born of the female, compares unfavourably with the cybernetically *enhanced* body, derived from masculinist technology.

This is not to argue for the displacement of the concept of the cyborg, which is undoubtedly important as a strategy, but its dominance does seem to preclude

imagining women as being entwined with technology in other ways, while much of the literature around the cyborg also tends to assume that such entwinement is always desirable. The assumption that being a cyborg is valuable in itself appears to have prompted a number of feminist writers to present the notion that particular social practices produce cyborgs as a conclusion in itself, without any consideration as to what this might mean in terms of posing new critical questions, or for the position of women or technology within social practices. Based on the amalgamation of binary opposites, it may provide a new conception of self, but as a fragile union, it possibly holds the danger of supporting patriarchy, as well as dismantling it. Despite its initial post-gender origins that still remain faithful to feminism, my suspicions are certainly aroused that Haraway eventually drew back, re-telling her powerful mythic creature, not as a post-gender cyborg, but as a “bad girl that doesn’t what to grow up” (Haraway 1991: 8). It seems that the cyborg, as useful as it is for unravelling the complex relations between technology and bodies, may be a dangerous creature, that should be approached with care; however it remains useful in focusing the importance of the bodily in critical accounts of technology.

1.5 Conclusion

Stone (1995c) suggests that we live at the close of the “Mechanical Age” - that flicker of time when the very mechanics of masculinist discourse are both stable and insecure. Its myriad of dualistic structures seem suddenly to have become visible and open to question. So while the fictions of male and female genders continue to shape the structure of society, and even as the feminised irrational Other supports the notion of objective, rational science, the myriad of feminist criticism and revisionist projects provide a nexus of growing dissent, and some loss of confidence in these binaries. For at the close of the twentieth century, the distinctions between Nature and Culture, Man and Machine and Man and Woman are disturbingly blurred, and the prospect of the cyborg has travelled from the pages of Science Fiction fantasy to the realms of possibility (Haraway, 1985). The populist fear that technology might consume or supplant humanity is only partially soothed by faith in its neutrality and the belief that it is merely the application of the most advanced

scientific knowledge. If we quiver on the edge of a time of monstrous technology and of technological monsters, what does this mean for the human subject? What does it mean for Woman, and women? For at the close of the mechanical age, *Man of Reason* has lost his credibility as the knowing subject, replaced by the possibility of multiple, contradictory, fluid and discursively constituted positions (Lloyd 1984). This thesis is concerned with this, and with technology. It is an attempt to tease out what subject positions are available or contrived or (re)produced through the interactions between technologies and bodies. It is a recognition of both the embedded nature of discourse, and it tentatively formulates the arbitrary distinctions between technology and the body only as an attempt to illuminate their integration.

This concurrent construction of bodies, technologies and discourses is the subject of this thesis. It is asserted that technology cannot be understood outwith its contextualised place within discourse, or without referring to its relationship to the body, for these facets are intimately related. That is, technology is a product of discourse and thus discursive structures influence and are reflected in the type of technologies we get. The body too is produced through discourse; however, as this chapter has also argued, neither technology nor the bodily are entirely discursive in their effects. Both technology and the body possess a degree of agency, which limits the ability of discourses to interpret them. In this sense, the interactions between technologies, bodies and discourses are mutually constructing, and mutually disrupting. To unravel these entangled threads to search for plausible meaning is a complex task, and one that must be approached. Simply to provide an image of technology as embedded does not provide a purposeful analysis for feminist and other revisionist projects, because it would not provide a basis for understanding that enables one to imagine how things might be structured differently. However it is vital to hold the contradictory notion that bodies, technologies and their discursive practice can be considered simultaneously separate and irrevocably intertwined. The division of the nexus is not however entirely arbitrary, for it refers to objects of analysis identifiable within discursive structures and within feminist theoretical analysis.

Situated within the theoretical perspectives explored in this chapter, this thesis will attempt to examine the relationships between GIS, its situated practice and its users. The feminist literatures outlined above provide a challenge to the neutrality of GIS, suggesting instead that it is a product of a number of competing discourses, which both actively construct it and are constituted by it. Such an understanding of GIS enables it to be viewed as a complex boundary object, which emerges through its interaction with the discursive. Adopting this definition of GIS, this thesis utilises the strategies developed by feminist theorists of science and technology to deconstruct these discursive structures, and to explore the socio-technical meaning of GIS as it is (re)produced through its situated practice. The feminist literatures explored in this chapter thus provide both a basis for interpreting GIS, whilst informing the methodological and theoretical basis of this project. Asserting the importance of situated knowledges, this account of GIS is not intended to be final or universal: stories about the practice of technology, as retold in section 1.3, constitute a reminder that as the social mediates the effect of the technical, these processes are fluid and unstable, and the effects of technology are thus always open to negotiation. Such literatures do however focus the importance of the discursive in the practice of technology, whilst providing strategies such as the cyborg and actor network theory which enable the complex nexus of social relations in which GIS is situated to be untangled.

This thesis focuses on the practice of GIS, exploring the processes through which its computing technologies and their users negotiate each other, and how these negotiations contribute to the co-construction of both users and GIS. This is explored by examining the situated practice of this technology in a single organisation, in order to access what meanings users attribute to the machine, and how these meanings inform their understandings of themselves and their practice. Given the theoretical framework suggested by the postmodern feminist literatures reviewed in this chapter, this research also attempts to assess how important the bodily is in articulating these relationships, and the processes by which the practice of this technology might produce corporeal forms. Mindful of the feminist theory

that informs the accounts of science and technology related in this chapter, this research endeavours to explore the role of gender in these processes. These empirical questions inform the basis of the substantive results presented in chapters three, four and five. In the following chapter, the methodology will be reviewed.

Chapter Two

Researching GIS at SNH

2.1 Methodological Choice

The purpose of this study is to approach the complex nexus of inter-relations between GIS and users, as they are (re)produced through their interaction with each other in specific social contexts. To address these issues, it is important to develop an appropriate research design. This is partly because the theoretical framework in which any research is situated informs how the empirical data is conceptualised, but also because the choice of appropriate research methods will be influenced by the specific data requirements of the issue being explored. The type of data collected therefore impacts the sort of questions it can be reasonably expected to address. Located by a postmodernist feminist account of actors and artefacts, as discussed in Chapter One, this project clearly requires a design sensitive to a theoretical framework which has rejected the notion of objective or universal truth, and instead provides data which are contextualised, local and capable of challenging the ideologies of both the researcher and the researched.

To access such material it became apparent that a qualitative approach, based on intensive in-depth interviewing was most appropriate. In-depth interviews reflect a movement away from questionnaire based techniques, which can imply that the researcher is fully knowledgeable in what the important questions are, and that a series of unproblematic or factual replies can be gathered from the range of informants; language being transparent. Instead, the in-depth interviewer adopts a more local and flexible approach, sensitive to the needs and complexities of each individual informant. The interviewer only identifies the initial broad topic, and the informant is encouraged to speak freely around it; reflecting the belief that it is not only what is told, but how it is related, and what is left out, that is significant (Thompson 1978). This approach is especially pertinent to this project as by utilising

discourse analysis, a method that asserts the centrality of language as a means of uncovering underlying assumptions, it becomes possible to access the meanings that individuals attribute to their experience of the technology; centring the importance of their contextualised encounters with GIS, rather than seeking transcendental facts. It also challenges the expert role that some methodologies presume for the researcher, allowing greater emphasis to be placed upon the contribution and direction suggested by the informant (Miles and Huberman 1994).

A single case study of the implementation of GIS in a large organisation was considered an appropriate focus for data collection. It was envisaged that researching GIS through a period of implementation would facilitate access to individual's developing understandings of GIS prior to the technology stabilising and becoming a transparent object, which was 'seamlessly' incorporated into working practices. This approach is advocated by Latour (1987), who asserts that by following developments as they occur, it is possible to uncover the process of construction prior to "black boxing". The single case study of a large organisation provided a suitable context for data collection. The extensive nature of such organisations offered opportunities to interview a large number of individuals, who were utilising and experiencing GIS differently. Whilst this strategy potentially provided a range of informants, that all the interviewees were situated in one organisation provided a common context to the processes of data collection and analysis. It was envisaged that this strategy would facilitate a more refined understanding of the organisational structures in which GIS was being utilised, and assist in the development of rapport.

2.2 Case Study Selection

The single case study selected was the introduction of GIS into Scottish Natural Heritage (SNH). SNH was an appropriate choice because at the onset of data collection for this project in September 1996, SNH was in the initial stages of implementing an ambitious £3 million GIS strategy, which entailed training the majority of their ecological staff to use GIS. SNH were therefore able to facilitate access to a range of new GIS users, who were adopting the technology in the context

of one organisational implementation. The SNH implementation involved various phases planned over a period of months, which co-incided with the data collection phase of this research. Investigating this process thus provided a unique opportunity to assess how GIS would impact both the organisation and the individual's experience of GIS technologies, before the practices surrounding it, and assumptions about it became established. This enabled me to collect data which would address the research questions identified in section 1.5, and to provide feedback to the informant organisation on their GIS implementation.

SNH was also partly selected for pragmatic reasons. The successful tender to provide the training programme was made by Edinburgh University's Geography Department, and this enabled me to negotiate access with relative ease. Although SNH were initially cautious that my research might be a burden on their staff time, without providing them with any tangible benefits, it was possible to convince them that this project would provide useful feedback on their GIS implementation. The GIS Project Board - an SNH committee responsible for implementing the GIS strategy - considered that I would provide a fresh perspective on the GIS strategy. They envisaged the interviews would generate information on how GIS was being used and enable possible limitations or problems to be identified with a view to providing early solutions. A member of the GIS Project Board was designated as a primary point of contact. Communications via email, telephone and occasional meetings, facilitated oral feedback throughout the project. He was able to keep me informed about developments in SNH's GIS strategy, and to assist me in logistical refinements to the design of this project throughout the period of research, whilst I was able to provide feedback from interviewees on pressing issues. The main form of feedback to SNH however was two business reports written by myself, which were submitted to the Project Board at different stages in the research (Appendix 1.1, 1.3). Written responses from the Project Board (Appendix 1.2, 1.4), together with informal conversations with staff and previous employees of SNH suggest that these were enthusiastically received, and contributed to refining SNH's GIS strategy. This approach thus constituted a successful collaboration, which ensuring SNH's co-

operation, ultimately provided useful feedback to SNH and the opportunity to collect rich research data.

2.2.1 SNH's remit and organisational structure

A brief account of SNH's remit and organisational structure provides useful context to the accounts of GIS provided in the substantive chapters. SNH is a government body, with offices throughout Scotland, whose brief is to promote good management and enjoyment of the Scottish countryside, as well as providing certain executive services to government. The aims of SNH are:

- “to safeguard and enhance Scotland’s natural heritage, particularly its natural, generic and scenic diversity
- to foster awareness and understanding of the natural heritage
- to promote quiet enjoyment of the natural heritage and to facilitate responsible public access to it
- to work in partnership with others for the benefit of the environment
- to improve the natural environment in and around urban areas
- to encourage environmental sustainability in all forms of economic activity” (SNH 1997).

These aims translate into a broad range of different responsibilities, job profiles and daily working practices, which result in a complex organisational structure¹¹ (Figure One). This includes local Area and Sub-Area offices, Regional Offices and central Headquarters in Edinburgh. The types of task undertaken vary greatly between these different types of office. At area level, staff are mostly involved in the natural heritage concerns associated with the immediate vicinity. A high proportion of staff time is expended on re-active management work, such as dealing with enquiries from the public, commenting on planning proposals or providing guidance on the management of SSSI and other designated areas. Local staff are however also involved in pro-active work, such as developing long distance paths. In contrast, the

¹¹ During the period of this study, SNH has undergone major re-organisation, which has involved changes to job descriptions, line management etc. Many central Directorate duties have now been re-allocated to local offices. The organisational structure suggested by Figure One is however only correct in general terms. A whole range of historical factors, for example, working structures inherited from predecessor organisations, mean that there are variations in organisation between the different regions.

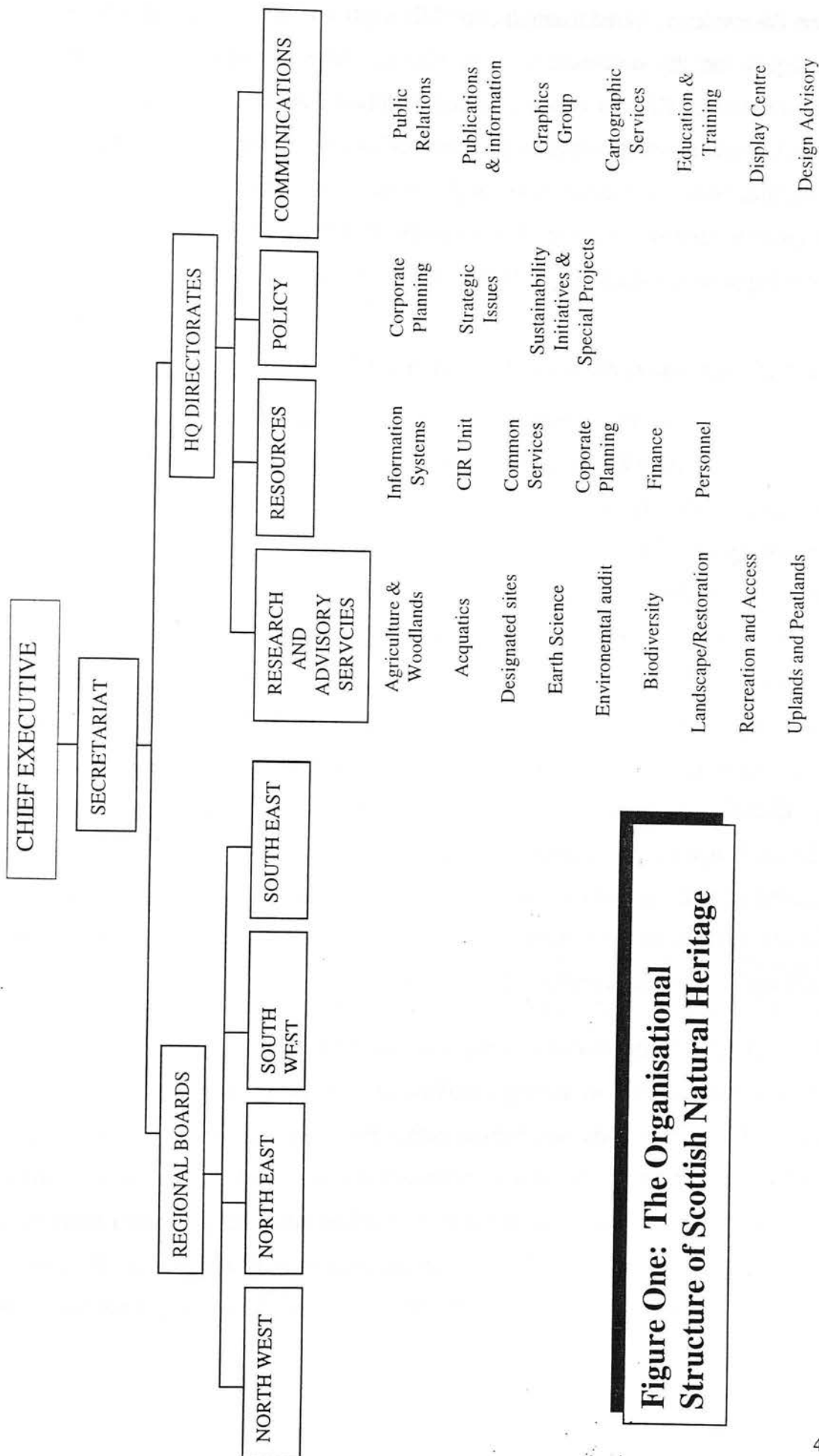


Figure One: The Organisational Structure of Scottish Natural Heritage

four Directorates, based centrally in Edinburgh are concerned with developing strategies for the organisation as a whole. Research and Advisory Services Directorate (RASD), for example, is responsible for commissioning or undertaking research, survey and monitoring on a Scotland-wide basis, providing both long term strategies, such as conforming to European Community (EC) legislation by designating Special Areas of Conservation (SAC), as well as liaising with and providing advice to the Area Offices on a daily basis.

2.2.2 Background to the use of GIS within SNH

SNH's use of mapping and other geographically referenced data is both extensive and intensive within the organisation, factors which contributed to the individual decisions of a number of departments to adopt the relatively new technology of GIS in the late 1980s. At this point there was no encompassing strategy for electronic spatial data management throughout the organisation, and this, in the context of the discrete agendas and requirements of different sections, led to the piecemeal adoption of GIS. Cartographic Services, located centrally in Edinburgh, were the first to consider the utility of this technology. This section is responsible for servicing both local and central staff by providing maps for use in publications, public enquiries and other forums, and for maintaining maps of the official designations required by EC and national legislation. They argued that an automated drafting system would provide higher quality mapping cost effectively. Several systems were benchmarked, including ArcInfo and Intergraph, which are two GIS applications marketed by different vendors.

Cartographic Services eventually selected Intergraph, a decision which provoked dissatisfaction amongst staff in other sections. Some GIS-literate SNH staff felt that Intergraph was chosen, rather than ArcInfo, because the benchmarks were geared towards the needs of computer-assisted drafting, rather than analysis. The story that Intergraph was selected because one could 'drag' a north arrow onto the map with one simple movement, as opposed to writing five lines of codes in ArcInfo, is recounted with mirth by GIS staff who championed ArcInfo as the

superior product for analysis work. This 'folklore' is intended to illustrate how ridiculous a choice Intergraph was, considering it was such 'trivial' reasons which led to its adoption. This arguably contributes to the notion amongst some staff that Intergraph is hardly a GIS at all. In response to this, shortly after Intergraph had been adopted by Cartographic Services, the Uplands and Peatlands section of RASD decided to implement their own system using ArcInfo. This was the only section in RASD exploiting GIS for analysis, this anomaly being attributed to the personal enthusiasm of key staff in that section.

The use of GIS was therefore historically confined to a small number of staff who were directly involved in using it. Although Cartographic Services were producing maps for the organisation as a whole, staff outside Cartography were not aware of the production process and did not equate the map products received with GIS output, while some staff were under the impression that maps were hand drafted. This was possibly because the cartographers were located centrally and thus physically remote from the majority of SNH staff, a factor which created an aura of mystique around their working practices. Additionally Cartography did not offer any analyses, which was integral to many interviewees' understanding of GIS. The introduction of GIS in SNH proposed in the new strategy therefore constituted a major sea change for both the organisation and its staff.

2.2.3 The GIS Strategy

In the mid-1990s, a review of the use of GIS within the organisation suggested that the piecemeal adoption was unsatisfactory, because it resulted in the duplication of systems and data, poor communication between colleagues utilising GIS and difficulties associated with incompatible data formats for activities such as data sharing. A GIS Project Board was convened and became responsible for formulating a strategy for SNH, and for implementing and monitoring its success. It comprised non-technical senior staff, who championed the technology, some highly skilled GIS SNH staff and non-technical staff. The Board included representatives from all the HQ Directorates and the four Regional Boards. Initially the Board

envisaged a small project, but on the impetus of the senior GIS ‘champion’, more ambitious designs were pushed forward, justifying GIS on a cost effective basis. The strategy was developed in consultation with staff throughout the organisation; however, as individual representatives were responsible for canvassing opinion, the nature and quality of consultation varied tremendously throughout SNH. In one Directorate, for example, the representative interviewed the head of each department in his section, while in another Directorate, the representative stopped attending GIS Board meetings altogether. This reflected the degree of enthusiasm of individuals for the technology, and suggests that this strategy was biased towards certain interests. However, like any technical implementation in a large organisation with diverse needs, the process of negotiation was intensely political, and some groups of staff assert that their needs were ignored or marginalised, despite their involvement in the consultation process.

The Board developed an ambitious GIS strategy to automate many of SNH’s existing working practices through the widespread introduction of GIS. This strategy, which proceeded directly to implementation without a pilot study, involved a long term project, which was intended to be fully integrated into the IT strategy. It entailed significant investment in hardware, software and the training of two hundred “front-line” staff from both central and local offices. The term front-line staff is used by management in SNH to broadly refer to staff involved in environmental management, as opposed to areas such as finance and administration. The Project Board’s vision was to transform SNH from an organisation, which was largely reliant on paper based data and traditional methods of analysis, into one in which the majority of front-line staff were conversant with GIS, and integrating it fully into their working practices. Rejecting the approach of creating a highly skilled GIS unit, which provided services to other staff, it was envisaged that providing basic GIS skills to the majority of front-line staff would enable more efficient access to data sets, improved data analysis and better presentation, particularly for map outputs. Historically GIS has been a complex application, which required a high degree of computer literacy, and in the past such a strategy would have been impractical.

However, the launch of what are termed “sister” products by large GIS vendors facilitated this vision. A “sister” product is a less sophisticated version of a proprietary GIS package, which has less functionality than the main product, but has the advantage of being able to run on a PC, as opposed to a mainframe, and of being easier to use.

The Project Board selected ArcView 2.0 - the sister product to ArcInfo - which having been recently released, and providing greater functionality than version 1.0, was timely from a technical perspective. This software runs in a Windows environment, which was familiar to many staff who had previously attended a two day training course on Windows, Word and Excel. Incorporating only some of ArcInfo’s functionality, this software could run on the current SNH PCs, provided they were upgraded with more memory, while output could be sent to standard laser printers. It differs significantly from ArcInfo, which requires powerful mainframe computers, has a command driven interface¹² and sophisticated functionality. Investment in hardware was limited to upgrading one PC to the required specification to run GIS in each Area Office or section.

A team of technical staff, acquired through new posts and by seconding existing employees, was formed, and located centrally in Edinburgh. This team, who were termed the Local GIS Facility (LGF), were responsible for mounting currently available data sets, and for providing user support in the early phases of the project. Data was mounted in two phases. The first phase was completed in December 1996, to co-incide with the installation of a GIS specification PC in all the offices and the onset of the series of training courses. The second phase of data was released in June, 1997, and included new data sets and refinements to the phase one data. A significant amount of the £3 million budget was devoted to training. This comprised a two day training course, which was put out to competitive tender. Nineteen courses plus one pilot course were conducted in all between September 1996 and June 1997. Grades of staff who it was considered would benefit from learning how to use GIS



were targeted. This group was invited to take the course, though the degree to which staff were encouraged or compelled to undertake training varied throughout the organisation, for example, depending on the enthusiasm of particular line managers for the technology. The vision was that once data sets had been mounted, and trained staff had achieved a level of competency, GIS would become integral to the working practices of SNH.

2.3 Data Collection

Background data for this project were collected through discussions with two members of the GIS Project Board, while the designated contact continued to provide background information throughout the process of data collection. To gain a fuller understanding of the GIS course that the interviewees were attending, I observed the first training course held in September, 1996. This was the pilot course, and as each two day session was intended to train ten SNH staff, the subsequent nineteen courses were slightly modified throughout the several months that the training series took to complete. The courses involved lectures on the theory of GIS, practicals using ArcView, information sessions from the LGF on SNH's specific implementation and some discussion sessions. My role in the pilot course was a non-participant observer. The notes taken during this course provided background material for the study, enabling an informed discussion of the course during subsequent interviews.

For the substantive data collection, the focus on the responses of individuals to GIS technology as it was introduced into their working practices, suggested a longitudinal approach would be most appropriate. This would enable informants to be interviewed at intervals to assess their on-going and developing relationship with GIS. A three round interview structure was agreed with SNH to allow informants to be interviewed before being trained to use the technology, and immediately after training, with a final interview some months later when informants had become more

¹² A command driven interface provides the user with a prompt, (e.g.: >) and the user types commands, rather than a graphical user interface, where the user can select options with a mouse or keyboard.

familiar with GIS (or not). It was envisaged that this would provide opportunities for assessing how preconceptions might influence an individual's response to technology, while also enabling a fuller picture substantiated by the passage of time: for example, the initial enthusiasm (or alternatively panic) genuinely felt by a user recently introduced to GIS could plausibly be expected to alter significantly by the final interview. It was anticipated that this intensive approach would facilitate a degree of depth. Re-interviewing the same informants seemed to provide a strategy which would promote a more refined understanding of their working practices, while it would also contribute to the development of rapport, which has been seen as a critical factor in the collection of rich interview data (Oakley 1981, Burgess 1984).

A smaller number of interviews were planned with employees who had already undertaken the GIS training course, courses having commenced some months prior to the collection of empirical data for this project. The decision to interview this group was partly based on practicality, for it provided a broader sample from which to draw potential interviewees than would have been possible other wise. However, it also enabled data to be gathered from a distinct group, that is those who had opted to undertake the course as soon as had been possible, while such staff also had had a longer period in which to develop their relationship with the technology. Additionally, single interviews were sought with six informants who were in the target group, but hadn't opted to take the course. These interviews were intended to explore the reasons why individuals might resist or reject the technology, usefully complementing the views of course attendees. This approach of choosing a sample from a general group as the dominant method of selection, in addition to seeking out individuals who may be assumed to have particular experiences or views is an established technique, for example, Pringle (1989) supplemented her interviews of secretaries with specific attempts to contact certain groups, such as aboriginal and feminist secretaries.

2.3.1 Selection

To gain a broad sample of experience with GIS a total of 42 informants were selected initially. It was envisaged that a proportion of those contacted would be unwilling to take part, or would later drop out of the study for a range of practical or personal reasons, and therefore this number was chosen on the basis that it would yield around 30 complete interview sets. The choice of informants who planned to attend the course or had already completed it was influenced by a range of practical and theoretical considerations. One such concern was the geographical distribution of SNH staff through Scotland, some being based in very remote regions. It was considered desirable to interview informants in their work places, partly because this was the most convenient way to access informants whose time was valuable, but also from a theoretical perspective, it provided an opportunity to meet the informant in their ordinary everyday setting. This allowed data to be gathered at the site of data production, enabling insights into informant's working practice (Thompson 1978, Burgess 1984). Limited finances and time constraints, exacerbated by the planned three interview approach, made it provident to concentrate on informants based close to Edinburgh. To broaden the possible range of experience, some informants were selected from regions elsewhere, while there was also an attempt to gain respondents from the different types of SNH office, being Area, Regional and HQ. The informants chosen were based at the Edinburgh Head office, the Regional offices at Edinburgh, Clydebank and Inverness and the Area offices at Dalkeith, Aviemore and Stirling.

An attempt was also made to provide some gender balance by interviewing approximately equal numbers of men and women. Female staff were slightly under represented in the list of future course attendees, despite the fact that the target population for the course was gendered balanced. This was because women had been over represented on earlier courses, rather than that women were opting not to learn the technology at all. 17 men and 13 women were selected from those expecting to do the course, while 6 men and 6 women were selected from those who had already completed. A range of different grades and jobs were also sampled to reflect the

diversity of experience possible within the organisation. The prospective interviewees were contacted in writing initially by the designated contact in SNH (Appendix 2.1), and subsequently by a letter from myself (Appendix 2.2), which detailed the nature of the project and the time commitment needed from them. This was followed up with a telephone call from myself to arrange an interview time.

2.3.2 First Round Interviews

Of the 42 prospective interviewees, who were either planning to take the course or had already done so, 27 of these round one interviews were undertaken. They were carried out between 15th January and 18th March, 1997, and included a range of interviewees in terms of job description, gender and grade (Table 1).

Table 1: First Round Interviewees: trained or about to be trained in GIS

	Sex	Name	Job Description	Date Interviewed
1	f	Joan	Area Officer	20-Feb-97
2	f	Sarah	Advisory Officer Landscape	13-Feb-97
3	f	Rose	Moray Firth Project Officer	07-Feb-97
4	f	Anne	Head of Landscape and Recreation	24-Feb-97
5	f	Kate	Area Advisory Officer	18-Mar-97
6	f	Judy	Area Officer	03-Feb-97
7	f	Carol	RAO Research and Survey	07-Feb-97
8	f	Tess	Landscape Advisory Office	07-Feb-97
9	f	Donna	Habitats & Species Directive Liaison	30-Jan-97
10	f	Sally	Advisory Services Support	03-Feb-97
11	f	Melanie	Area Officer/Community Projects Officer	05-Mar-97
12	f	Laura	Area Officer	18-Mar-97
13	f	Lucy	Research and Advisory Office	12-Feb-97
14	f	Fiona	Mapping & Charting Office	25-Feb-97
15	m	Nigel	Area Officer	04-Feb-97
16	m	Gary	RAO Freshwater Management	17-Jan-97
17	m	Richard	Habitats & Species Dir. Co-ordinator	20-Jan-97
18	m	Simon	EC Directive Support Officer	15-Jan-97
19	m	Terry	RAS Support	29-Jan-97
20	m	Alan	RAO Peatland Ecology	31-Jan-97
21	m	Danny	Site Documentation	21-Feb-97
22	m	Steve	RAO Statistician	27-Jan-97
23	m	Jaik	RAO Structural. Geology, Mineralogist	03-Feb-97
24	m	Colin	RAO Upland & Peatlands	10-Mar-97
25	m	Bill	RAS Support	03-Mar-97
26	m	Pete	Marine Habitats & Species	11-Mar-97
27	m	Duncan	Peatlands GIS technician	30-Jan-97

Fourteen interviews were conducted at the HQ in Edinburgh, one in the Edinburgh Regional Office, six in Clydebank Regional Office, three in the Inverness Regional Office, one in Aviemore Area Office and two in Dalkeith Area office. In order to maintain confidentiality, pseudonyms have been adopted in this thesis. This approach was chosen, rather than a numbering system, as it preserves the sense of individual respondents, while it also makes it easier for the reader to follow analysis of comments made by the same interviewee.

Findings from these interviews prompted a modification to the research design. This was an appropriate response, as research design and implementation should not be seen as a linear process, and the researcher should be sensitive to modifying the methodology where necessary (Burgess 1984). The first round interviews suggested that SNH's ambitious strategy was not leading to the widespread adoption of GIS. Despite general levels of enthusiasm for GIS, its actual use within SNH was limited. Data gathered in the first round of interviews suggested that approximately half of trained staff had not used the software at all, while a further quarter had benefited from little or limited use. These findings were consistent with other staff's perceptions of uptake within the organisation, as well as surveys undertaken by LGF. This tended to result in interviews focused around the experience of not using GIS, which albeit an interesting finding in itself, prompted the concern that interviews focused on actual experiences of the technology were lacking in the sample. This led to a change in strategy, with an additional four interviews being undertaken with staff selected specifically for their high GIS use (Table 2). These interviewees, who were termed 'super users' by the LGF, were selected by the designated contact.

Table 2: Super Users

	Sex	Name	Job Description	Date Interviewed
1	m	Joe	Area Officer	28-Apr-97
2	m	Keith	Area Officer	23-Apr-97
3	m	James	Regional Advisor	20-Jun-97
4	m	Charlie	Habitats Directorate	21-Jun-97

2.3.3 Interviews with Staff not training to use GIS

Only two interviews were undertaken with staff who had elected not to do the course (Table 3). This change in approach became necessary because during the course of the research, it became apparent that interviewing staff who were not going to be trained was not a productive strategy. The two interviews undertaken, in addition to telephone conversations with other staff in this category revealed that they had usually not opted to do the course for a range of logistical reasons, for example, they were going to be away on field work for extended periods, or that they already had GIS skills. A number of staff in this category were unaware that the course was available, reflecting general communication difficulties within SNH, especially in terms of the GIS consultation process. Although such information was useful to SNH, it meant that this group wasn't a coherent category to form the basis of analysis.

Table 3: Interviewees in the Target group, who were not planning to take the course

	Sex	Name	Job Description	Date Interviewed
1	m	George	Sea Eagle Officer	22-Jan-97
2	f	Helen	Area Officer	11-Feb-97

2.3.4 Round Two Interviews

Low levels of uptake necessitated refining the methodology originally envisaged. Interviewees who had been trained prior to their first interview, and had never used GIS, were reluctant to be re-interviewed only to repeat the views they had expressed in the first interview, and although their perceptions and reasons for not using GIS may have altered, re-interviewing did not seem a productive strategy. Where possible, interviewees who had not been trained prior to the first interview, were re-interviewed, in addition to first round interviewees who were using GIS. Fifteen second round interviews were undertaken (Table 4). This round was carried out between the 14th June and the 15th July, 1997, and included seven interviews at the Edinburgh HQ, one at the Regional Office in Edinburgh, four in Clydebank Regional Office, one in Inverness Regional Office and two in Dalkeith Area Office.

Table 4: Second Round Interviewees

	Sex	Name	Job Description	Date Interviewed
1	f	Sarah	Advisory Officer Landscape	27-Jun-97
2	m	Nigel	Area Officer	18-Jun-97
3	m	Colin	RAO Upland & Peatland	13-Jun-97
4	f	Judy	Area Officer	10-Jun-97
5	f	Fiona	Mapping & Charting Office	15-Jul-97
6	f	Laura	Area Officer	16-Jun-97
7	f	Tess	Landscape Advisory Office	02-Jul-97
8	f	Donna	Habitats & Species Directive Liaison	13-Jun-97
9	m	Alan	RAO Peatland Ecology	14-Jul-97
10	f	Melanie	Area Officer/Community Projects Officer	18-Jun-97
11	m	William	RAO Freshwater Management	11-Jun-97
12	m	Terry	RAS Support	05-Jun-97
13	m	Simon	EC Directive Support Officer	27-Jun-97
14	m	Danny	Site Documentation	23-Jun-97
15	m	Duncan	Temporary Peatlands GIS technician	04-Jun-97

2.3.5 Third Round Interviews

The third round of interviews was abandoned. This decision was partly practical: the interview material collected in the previous rounds proved incredibly rich, and together with the willingness of interviewees to engage in lengthy interviews, this meant that the first two rounds yielded far more material, which required careful analysis, than was originally envisaged. Additionally, preliminary analysis of first and second round interviews suggested that the views of interviewees did not alter significantly between the interviews. This may have been because many of the interviewees had not had substantially more experience of the system by the time the second interview was conducted; however this might also reflect that the process by which interviewees would gain experience of GIS was fundamentally misconceived. I initially envisaged that interviewees would be first exposed to GIS on the course, and then progressively become proficient at using the software; however many interviewees had some experience of GIS prior to the course, for example, from previous employment or educational programmes, or were exposed to the system as it was used by their colleagues at SNH. Thus, while some interviewees had had minimal further experience between interviews, others had adopted ArcView into their working practices prior to taking the course. The amount of time which had lapsed between the interview and the course therefore did not provide a coherent

factor for analysis. Although views provided in third round interviews may have been governed by differing processes and been markedly different, similarities in the data collected in the first two rounds never-the-less contributed to abandoning the third. This decision was made in consultation with SNH, who also felt that further interviews at that point would not yield further useful information on their implementation.

2.3.6 Interviewing Style

Interviewees were told that interviews would last approximately 45 minutes, although in practice they tended to last longer than this. In accord with the theoretical perspective of this project, a non-adversarial 'listening' approach was adopted for all the interviews. Although a schedule was devised for each, attempts were made to ensure a free flowing feel to the interview, and to limit the number of questions asked, so as to encourage the informant to recount what they considered was important in relation to the topic at hand. This technique rejects the more confrontational approaches suggested by geographers such as Schoenberg (1991, 1992), who argues that questioning informants on similar themes enables the verification of data, and that challenging apparent inconsistencies in the informant's account will keep the subject 'on their toes'. Instead it affirms the theoretical position that no singular reality, which can be externally validated exists, and therefore it is the beliefs of the informant which are significant (McDowell 1992).

An attempt was made to phrase questions simply, and to avoid leading questions. In the first round, four broad themes were raised: current working environment, current knowledge of GIS, the GIS course and expectations for the future. Generally interviews began with questions about the current working environment, revolving around what the interviewee's job entailed, their working practices and their current use of different technologies. This background information provided context to their experience of GIS, and provided a strategy for starting a discussion and developing rapport. Questions around their current knowledge of GIS included their experience of the consultation process within SNH,

where, if at all, they had accumulated knowledge about GIS, and whether they were currently using it, or having GIS services provided for them. Interviewees were asked to comment on the GIS course, for example, explaining why they had signed up for it, and what their expectations or experience of it were. The final theme concerned their views on the future of GIS, both from a personal and organisational perspective. These themes were adapted for different interviewees, for example, those who did not do the course were asked what reasons had influenced that decision. For the second round interviews, individual schedules were devised for each interviewee, which reflected the issues raised by them in their first interview.

Each interview was conducted in a private office or meeting room to ensure that interviewees were able to speak as freely as possible, and to ensure good audio recording. All the interviews, except two, were tape recorded, with permission being sought from informants during the initial contact. One interviewee, who was interviewed twice, declined to be taped. Taping the interviews enabled a verbatim record of the interview to be collected, and dispensed with the distraction of attempting to keep detailed notes during the interview. This strategy therefore enabled fuller concentration on the process of the interview itself, enabling a more responsive style to be maintained (McCracken 1988). All participants were assured that the content of our discussion would be kept confidential, and that transcripts or tape recordings of their interview would not be made available to SNH, while any material presented in the reports would be made anonymous. This level of confidentiality was intended to inspire trust, and hopefully enable them to speak more freely about their experience of GIS, rather than merely recounting a company line. Certainly interviewees did appear comfortable enough to make a range of comments, and, in the context of an implementation which was not operating smoothly, did make extremely negative, as well as positive comments.

2.4 Conducting the Interviews

If the interview is considered a process, rather than an objective tool, it becomes necessary to consider one's own role, and the influence of the specific

positionality of the researcher (Miles and Crush 1993, Baxter and Eyles 1997). Critical practice, which is aware of the intersections between knowledge and power, is problematised by the intricacies of language and the difficulties of self-reflection. Any claim to knowledge should be self-reflexive, that is the circumstances of its production should be made explicit, in order to reveal its biases, exclusions and partiality (Latour 1987). This suggests that, among other things, it is necessary to include self-identity, and the identities of others in relation to ourselves, in order to displace the myth of the all knowing researcher; however this creates the dilemma of how can one know oneself, as reflexivity assumes a distance from which the self can stand back and view itself impartially (Rose 1995a).

Clearly my identity, as it was interpreted by interviewees, impacted the data collected. I want though to resist the temptation of 'situating' myself for the reader through a string of social identifiers, such as race and class. Although this is a strategy which has been adopted by other feminists to embody their theorising, these terms are not only contentious (to myself as well as others), but possibly shed little light on how interviewees might have interpreted me (Rose 1997). Instead, I want to contend that reflexivity is achieved most effectively when the researcher situates their knowledge claims by making explicit the methodology they have adopted; enabling the reader to access the means by which conclusions have been reached. Recognising the utility of this approach, this chapter has detailed the methodology; however it seems germane to also reflect upon the relationship between the interviewees and myself. Whilst it is impossible to be fully knowledgeable about my own position in the interviews, it is possible to reflect on the interviewing process in terms of the very specific ways in which the interviewees and I related. Such reflection was necessary in the process of data collection and analysis, while it also provides context to the excerpts that follow in the substantive chapters.

Some researchers have suggested an almost binary power relation between researcher and researched, where the informant is either more powerful than the researcher, for example, the corporate director graciously granting the junior researcher an audience (Schoenberg 1991), or alternatively the researcher is

perceived as empowered in terms of their professional position and ability to construct interpretation, appropriating the experience of minority groups (Nast 1994). My position in these interviews does not seem to conform to this binary opposition, rather power was mobile and fluid, operating to different effects with different interviewees, and at different moments within the same interview. Although the interviewees were a highly educated group of professionals,¹³ whilst I could be described as a student researcher, the interviewees, as a group, didn't adopt a dominant role.

In the course of the interviews, I seemed to occupy multiple positions: a fellow researcher, a 'proper' academic, a young woman at the start of the career ladder, a GIS expert or fellow 'champion', a human geographer, to name but a few. Interviewees were generally pleasant and friendly - I got tours and cups of coffee, and offers of lifts to stations; however interviewees differed greatly in how they reacted to me, often mobilising understandings that applied to their own position. Champions of the technology were often keen to write me as ally, eager to discuss the benefits of GIS, particularly in the context of their colleagues' disaffection with the technology. In contrast, others, such as Tess, who worked within the recreation remit of SNH and felt that cultural concerns were marginalised by scientific staff, was equally eager to engage my empathy. Her initial coolness when I organised the interview evaporated as she realised that I was concerned with users' experiences of the technology, rather than the technical implementation. In some respects, the fact that many of the interviewees were involved in research made them more amenable to co-operating with mine, and affected their understanding of the interview process. My position in the interviews was thus fluid, and I was aware, and able to exploit the notion, that I was multiply positioned.

Spending so much time in SNH also impacted how I was interpreted by the interviewees. The longitudinal approach was initially adopted in order to facilitate rapport; however it quickly became apparent that my frequent presence and

¹³ Nearly all the interviewees had a first degree and many had a post-graduate qualification. One interviewee had a Ph.D.

familiarity with the organisation created rapport without interviewing the same person multiple times. Simple things, such as knowing my way to a meeting room, being acquainted with colleagues and understanding the signing in procedure all contributed to this. As in many large organisations, there is 'culture of complaint' in SNH concerning how bad certain structures and conditions are, such as pay, contracts and communications. As I became more familiar with SNH it was assumed that I knew about it, and was complicit with this culture. This is exemplified by the following two anecdotes. Prior to my second interview with Danny at Anderson Place, we went into the coffee room. It was empty, but all the newspapers on the table were open on the jobs page. He looked at me and laughing, said - "I bet that doesn't surprise you?". My returning smile reflected my understanding and a degree of complicity. The other occasion was at Clydebank in the kitchen with Judy. We were laughing about something, when Sally (another interviewee of mine) popped her head round the door, and suggested that my presence explained the mirth, as I wasn't employed by SNH. This assumed complicity seemed to encourage interviewees to speak more freely, especially in terms of voicing criticism of the GIS implementation.

Being multiply positioned does not reflect insincerity on my own part, but rather resonates with my own ambiguities. This is particularly true of my ambivalent relationship with GIS. Within my academic department, I am frequently positioned as computer literate by human geographers and as a non-technical human geographer by colleagues engaged in GIS research. I exploited this ambivalence in the course of the interviews, as I was able to empathise with interviewees that found the technology problematic, and those who were embracing it. So while Tess was more comfortable talking to me once she discovered I was interested in human relations, I was also able to develop rapport with those who were enthusiastic about the technology. Whilst interviewing Lucy, for example, I commiserated with her terrible software problems by laughing with her, and commenting "welcome to the club". By accepting that the researcher is always positioned, and by explicitly

acknowledging this, this strategy enabled me to develop rapport with interviewees, and provided a basis for yielding rich interview data.

2.5 Analysis

The forty-six taped interviews were transcribed,¹⁴ and analysed using discourse analysis, which is an approach which is appropriate to all types of written texts. As a method which moves beyond viewing the interview process as an objective tool, where language is merely a medium of communication, it provided an approach that was consistent with the theoretical perspective and aims of this study. In discourse analysis language is placed at the centre of social life, and attributed primary importance, for it is understood as a medium through which the underlying assumptions that found discourse can be discovered, rather than as a pointer to a naively given 'real world' (Parker 1988, Marshall and Wetherell 1989, Opie 1992). It challenges the notion that language is the transparent means through which social actors express themselves, situating each utterance instead in the broader discursive systems in which it is embedded. Drawing on post-structuralist accounts of intentionality, it asserts that language functions at different levels, and that social actors mobilise and support different discourses through their utterances. Language therefore has multiple functions, so that an utterance which functions to make a request, for example, mobilises and (re)produces discourse. Where discourses have become so powerful that they have become naturalised, discourse analysis constitutes a means of unpacking them to reveal their constructed nature, and therefore the discovery of function is the end point of analysis (Wetherell and Potter 1988).

¹⁴ The tapes were transcribed by myself. This approach has been criticised as leading to unprofessional transcripts ridden with error, frustration and over familiarity with the texts, that does not aid later analysis (McCracken 1988). The decision to transcribe them personally was justified in practical terms: the project lacked finances to employ an audio typist, and as I am a professional audio typist, and have transcribed interviews for other projects, this strategy maintained quality control. However, having had the experience of transcribing the interviews, I disagree with McCracken's suggestion that transcription leads to over-familiarity. Rather the intimate knowledge of the interviews aided analysis, and resulted in analytical note making during transcription: conflating the different stages of research.

Discourse analysis understands language as structured to generate meaning, constructing lived reality. The approach to discourse analysis adopted in this research is situated in the hermeneutic strand, which focuses on the ability of social actors to produce meanings as they construct social definitions of lived experience. This suggests that the social does not pre-exist to be discovered, but is produced through these accounts. This differs from the structuralist approach, where utterances are used to reconstruct a social world, which each informant has a fragmentary and imperfect knowledge of, and the researcher is thus interested in combining these fragmentary accounts to reconstitute a fuller and truer description of social life (Parker 1988). Deconstruction within the hermeneutic strand enables the social context to be unravelled from the text, and is appropriate to the theoretical aims of this study, which has argued that both technologies and body are both constituent and active in the production of the discursive. This approach, although labour intensive, thus has the advantage of doing justice to the complexities involved in these processes.

The interviews were analysed by developing codes to which excerpts of interview transcript could be attached. This had the effect of re-organising the material from chronological into thematic order. The first round of interviews, together with the super users and non-course attendees, were analysed first. The object of this analysis was to determine the categories and assumptions that informed interviewees' experience of the technology, for example, the types of imagery exploited and concepts mobilised. The codes were developed using grounded theory, by analysing what categories and ideas interviewees drew on, as they attempted to describe their interactions with the technology. This approach to data analysis thus seeks to unpack what is important to the informant, rather than analysing the data on the basis of theoretical assertions (McCracken 1988). This was achieved by reading through each interview and taking note of a small number of key words for each page of transcript. Although this was a qualitative process, it did enable a degree of rigour, which grounded the codes in the utterances of interviewees.

This process produced approximately 600 key words, which were entered into an EXCEL spreadsheet. These data were sorted into alphabet order, which in part placed similar codes together, for example, “accessibility”, together with “accessing data” and “accessing hardware” were mentioned in a large number of the interviews. This spreadsheet formed the basis from which to identify broad codes. Fifty codes, which related to the key words, were developed from this process. In order to verify the validity of the coding scheme, the key words were all coded as an initial step before proceeding to the interview data. These codes included categories such as ‘future’, ‘enthusiasm’, ‘systems down’, ‘awkward’ and ‘useful’. In order to ensure that the codes were uniformly applied throughout the coding process, a descriptive sentence was written for each one word code, which attempted to clarify and maintain its meaning throughout the process of analysis. (See Appendix 3.1 for a complete list of codes and their descriptions).

The transcriptions were coded using HyperResearch qualitative data software. Mindful of debates within geography, that suggest that data analysed by software reflects the biases of the product, HyperResearch was used purely as a tool to aid data management, rather than to produce any preliminary analysis or coding categories (Okely 1994, Hinchliffe et. al. 1997, Crang et. al. 1997). HyperResearch, for example, incorporates functionality that enables the analyst to auto-code, that is the software codes excerpts on the basis of a search for a user defined word. This was rejected as an approach because interviewees often used different words to describe similar processes, for example, interviewees would rarely self-identify as being fearful of the computer, but might discuss their unease, apprehension or anxiety. Similarly, interviewees would sometimes use the same word, to talk about different things. HyperResearch also has hypothesis testing functionality. This enables the analyst to ascertain the effect of one code on the other, for example, whether interviewees who are ‘fearful’ are also ‘enthusiastic’. However this didn’t prove useful because aside from the problem that it implies a causal relationship between two unrelated factors, the software could not attempt to determine exactly the meaning of the interviewee. Thus the incidence of ‘enthusiasm’ for example, as a

code attached to an interview could mean that the interviewee was enthusiastic, or wasn't, or that they felt they should be, or that colleagues were. Clearly in this context hypothesis testing has little utility.

HyperResearch was therefore used only to attach the manually derived codes to excerpts, and to re-organise the material into coded categories. For some codes, secondary analysis based on secondary coding was undertaken. Where the resulting excerpts for a particular code produced many pages of data, it proved more manageable to repeat the process outlined above. The pages of coded data were read to determine new codes at a finer degree of detail. In these instances, codes were established which were grounded in the data, in addition to some analytical categories, which emerged from reading the result file. The 'physical' code result file, for example, was secondary coded with fourteen new codes. These included codes grounded in the data, such as 'touching the machine' or 'being outside of the machine', and analytical categories, such as 'attributing agency to the machine'. It was possible to develop analytical categories confidently for this secondary analysis, as the smaller volume of data, (for example, 5,000 words in the physical code result file, as opposed to 300,000 in the first round interviews,) enabled patterns to be ascertained. For the second round interviews, an attempt was made to apply first round codes to these transcripts, in order to ascertain whether they would be applicable. The codes continue to apply broadly, though the coding system was refined slightly to encompass new issues.

Each coded category was then analysed. This entailed a careful reading of the result file to establish which patterns and processes were important. Notes were written around the quotes, and these were developed into a piece of text which provided example quotes and analysis for each code. These texts examined inconsistencies and similarities in the ways in which the GIS was conceptualised. Particular attention was given to metaphors and other imagery. In recognition that the transcripts provided only a partial account of the interview, for example, tone, laughter and expression are all largely excluded from the text, the original tapes were played again. Although this did not in any sense provide a complete experience, it

did recall a fuller one. The original chronological transcripts were also consulted, to re-constitute the ideas expressed in the coded result files into their original context. The analysis of the coded data therefore attempted to provide a thoughtful response to issues raised in the interviews, exploiting all the data that had been collected.

Quotations from the interviews are used to support the discussion in the substantive chapters. The interview transcripts are verbatim records of utterances made in the interview; however the excerpts in the chapters have usually been edited. There are two types of edits: firstly, where a large section of intervening text has been edited out, usually because it hasn't been relevant to the point being illustrated, it has been replaced by a long string of full stops. The second type is used to improve the readability of the quote. The repetition of words, and phrases such as "y'know", "sort of" and "I mean" have been replaced by three full stops, except where the hesitation or repetition was judged to be significant. This strategy holds the disadvantage of appropriating interviewees' language, and of possibly editing out important nuances; however this is counterpoised by improved readability, and the fact that the written word is very different from the spoken. To utilise verbatim quotes tends to make interviewees sound inarticulate, and therefore the edited quotes attempt to capture the 'feel' conveyed in the interviews. Where quotations have been presented to support analysis in the subsequent chapters, sections of the quote have sometimes been highlighted in bold. This device was adopted simply to draw attention to particular sections, and does not reflect any emphasis on the part of the interviewee.

2.6 Ethics

The ethical consideration that assumed prominence for me during the course of data collection and analysis was the way in which I was positioned in relation to my interviewees. The notion that I was multiply positioned, and could adopt differing strategies to develop rapport with interviewees, who had diverse opinions, did occasionally make me feel uncomfortable, despite its foundation in my own sincerely held, but deeply ambivalent views. This reflects the dilemmas of the

double edged nature of developing rapport, for although the researcher must be flexible and set the interviewee at their ease in order to gather rich data, one must also guard against prompting them to reveal opinions that they wouldn't necessarily articulate if they were more fully aware of the circumstances in which they made these utterances.

I attempted to address these issues by ensuring that interviewees were able to give informed consent and by preserving confidentiality. It is difficult to judge whether consent was adequately informed. It would have been impractical to explain my theoretical perspective to each interviewee; however the project was explained briefly and interviewees did have an opportunity to decline to be interviewed or taped. Many prospective informants decided not to participate, whilst one interviewee declined to be taped, which suggests that the opportunity was a real one. Confidentiality was maintained by respecting explicit or implicit confidences, though again it was not always easy to assess what constituted privileged information. Challenges to confidentiality occurred frequently during the process of research, as staff were naturally curious about other people's views, or about the identity of the colleagues who had made specific comments in the feedback reports. Such challenges were always rebuffed, and may have had a positive effect, as such rebuttal assured staff of my discretion.

The affect of reporting to SNH on how I might be perceived by interviewees was a concern when setting up the research. Although it was essential to enlist the support of SNH as an organisation in order to gain access, I was anxious that interviewees might feel they were being assessed on behalf of senior management. This held the potential danger that they would attempt to tell me what they thought I would want to hear. In some respects, this would still have yielded useful data, as discourse analysis seeks to unpack the underlying assumptions that interviewees mobilise; however it would have provided a further layer of complexity to the data, which would have made reporting back to SNH difficult, as well as inhibiting my ability to untangle the complex array of material and discursive influences on this implementation. In order to minimise this problem, the GIS contact and myself

agreed a strategy for presenting me as independent. His initial memorandum to prospective interviewees explicitly stated that I was “completely independent” (Appendix 2.1), and this, together with a guarantee of confidentiality, was reiterated by myself at the start of each interview. Interviewees did appear willing to speak freely about GIS. In retrospect, I consider that this was only partly because they felt confidences would be maintained. The organisational ethos of SNH appears to be one in which staff feel comfortable articulating their views on working practices, whether they are complimentary or not.

Ironically, the more pressing issue that emerged was that of reporting the theoretical findings of the research. Many of the staff and ex-staff at SNH are graduates of the Edinburgh University Geography Department, which runs a one year taught M.Sc. in GIS and has strong research interests in the field. Numerous professional and personal networks therefore hold the two organisations together, and since I had previously completed the M.Sc. course and had a profile in the department as the only social researcher of GIS, I was fully implicated in these networks.¹⁵ Throughout the course of this research I had to be diligent to maintain confidentiality, for example, ensuring transcripts were collected promptly from the printer, or ensuring that a theoretical observation in an academic forum could not be transformed into gossip. A one day conference, open to past students of the M.Sc. course, presented particular difficulties, as it precipitated contact with interviewees as they occupied different roles. Presenting the findings of research to an audience comprised of academics and GIS practitioners, which included actual informants, in addition to other staff directly involved in the SNH GIS implementation, provoked the concern that interviewees would not recognise themselves in the findings of the

¹⁵ In retrospect I realise that utilising this case study was a personally risky strategy. My M.Sc. dissertation was a feminist critique of GIS, and this, together with my position as the only human geographer interested in providing a social critique of GIS, my work attracts interest in the department. Responses have ranged from supportive, to curious, to derision through to outright hostility. It's difficult to say to what extent interviewees were made aware of these interpretations of my research; however responses from SNH did feedback into my working environment. Fortunately SNH were very positive about the feedback they received, and this was relayed back to me by colleagues in the department on numerous occasions. Presumably the notion that the feminist, who had written what were often perceived as ‘unusual’ accounts of GIS, could also write useful business reports, served to (re)produce my own identity.

research, or might feel that their utterances had been misinterpreted in the light of a theoretical perspective which is foreign to those usually associated with GIS research. Clearly this is a difficulty for all researchers, and one that can only be addressed by the analyst's attempt to provide an honest account. This issue will be re-visited in section 6.2.

2.7 Themes

The analysis of the coded data formed the basis of establishing links between the different codes and the development of themes. The objectives of this research were to assess the on-going interpretations of GIS mobilised by staff at SNH as they gained competency with the application, and to evaluate how these understandings contributed to the iterative production of both the technology and users. As it became apparent through the process of data collection that the longitudinal approach was not useful in the context of this case study, the idea of organising the analysed material on the basis of the length of time the user had been exposed to the technology was abandoned. Given that many interviewees were only interviewed once, and that the analysis of interview material found there was no discernible pattern of difference between first and second round interviews, no distinction is made in the substantive chapters between first and second round data. The coded data was analysed with a view to addressing the research questions outlined in section 1.5. This involved focusing on particular codes which initial analysis suggested related most closely to the research questions posed.

Prior to the data analysis phase, review of the literature suggested that understandings of GIS might emerge through the co-construction of embodied users and the technology as they were performed through discursive structures. The tensions between the user, GIS and discourse were thus identified as possible important themes. Analysis of the data suggested that this was not an appropriate framework for understanding interviewees' interpretations, ostensibly because discursive structures were so embedded in the iterative co-construction of GIS and users that it was misleading to conceptualise discourse as distinct. Rather

interviewees appeared to gather understandings of the technology from its situated practice, while this process informed the production of both themselves and GIS. The body emerged as a significant element through which understandings of the technology were articulated. This included, not only the construction of an embodied user and distinct user subjectivities, but also the construction of an embodied technology. Users' understandings of GIS therefore derived from the interaction between the GIS, the user and its situated practice.

This analysis of the interview material provided the basis for developing an analytical framework centred around three themes. These themes, which emerged from the data, are explored in the following three substantive chapters, and include the practice of GIS, locating the embodied user and the agency of the technology. Chapter Three examines the discourses which (re)producing GIS, enable it, through the operation of power, to construct particular geographies. In Chapter Four the focus is on GIS users. GIS is explored as a site for the production of bodies and the construction of multiple user subjectivities. The final substantive chapter examines the agency of the GIS itself, and the production of the embodied machine. For where the technology is understood as culturally coded and material, both understandings of GIS and the body of the machine are concurrently produced through the practice of GIS.

Chapter Three

The Practice of GIS

"We've had some fairly sophisticated DTM GIS analysis done for this particular case. It went to public enquiry, and we based a lot of our ... landscape ... objection on this, ... it was very persuasive, because **it was based on data that was inarguable** we don't know the result of that enquiry yet, but it did help us to have a much more **scientifically viable argument** than other wise just saying it was going to be a bad effect on the landscape".

Anne

3.1 Introduction

The notion that GIS is a materially accurate representation of the 'real world', which, based on indisputable data, provides a basis for "scientifically" justifiable decision making, incorporates the concerns of many social critics of this technology (Lake 1993, Taylor and Johnston 1995, Pickles 1995, Curry 1995b). Regarding GIS as a development within the geographical tradition of positivism, such critics note a disjuncture between this field and other contemporary theory in human geography, where concepts such as contextual knowledge, contingency and socially constituted spaces have contributed to a powerful critique of the positivistic paradigm. GIS has been criticised for its insensitivity to the social construction of data, especially in terms of the privilege it affords to official sources, and for its lack of concern with meaning and interpretation, particularly with regard to the problematic relationship between the GIS image and material reality. It has also been suggested that GIS has paid scant attention to the political context of geographic information, and the relationship between the information generated and its uses (Gilbert 1995).

In response, GIS geographers have often sought to defend it, precisely as an objective, scientific method, that holds the promise of distilling pure geographic truths (Openshaw 1991, 1992). Another retort has been to criticise the social geographical literature for lacking an empirical basis. The tendency to direct

critiques of this technology at the theory of GIS has suggested to some proponents of GIS a reliance on asserted behaviour, at the expense of observed practice (Harvey 1995). Concurrently, the lack of empirical work on social and human issues within the field of GIS has also been recognised by GIS practitioners as an obstacle to developing constructive critiques of GIS and models of good practice (Eason 1993). GIS researchers have argued that only intensive empirical study, through qualitative techniques, such as interviewing, and quantitative methods, such as controlled usability trials, will provide access to user's experience of GIS, and enable the development of theory grounded in empirical study. The need to contextualise these issues within the situated practice of GIS has thus become compelling.

This chapter explores the mechanisms through which GIS, as utilised in SNH, is embedded within the discourses of Western Science. In the first section, I will argue that complicit with the broader scientific project, GIS provides a nexus through which the operation of power invested in these discourses, enables it to be (re)performed as credible, impartial and unarguably true. Thus this distinct enactment of power/knowledge produces and reproduces particular geographies of the world, while it also relies on and sustains a specific construction of spatial relations. In the second section, the importance of the visual will be explored, examining the ways in which the notion of the visible supports discourses of Western Science, enabling the GIS image to be conflated unproblematically with the material world. This theme is expanded in section three, where it is argued that magic and wonder, enacted through the visual medium, are integral to both the position of GIS within scientific discourse, and to its potent portrayal of the 'real'.

Yet my concern here is also with the limits of discourse - what lies on the edges of this coherent force, which both challenges and disrupts it. The fourth section will therefore examine the tensions between the 'real world' and the GIS image, while this chapter will conclude by exploring the complex, and often ambivalent relationship between GIS and its users that such tensions produce. In so doing, I concur with proponents of GIS who have criticised the lack of empirical basis from which critique of this technology has been developed. For it will be

argued that far from adopting rigid positions of naïve empiricism, the relationships that evolve between interviewees and systems are fluid and complex, and affect how GIS is understood and practised.

3.2 GIS as Science

Debates concerning whether GIS should be viewed as a science or a tool have attracted interest within the field (Wright et. al. 1997, Pickles 1997). This discussion focuses on the disjuncture between an understanding of GIS as a tool, where “neutral” hardware and software supports applications, and viewing GIS as a sub-set of geographical science. Wright et. al. (1997) suggest that GIS can only be considered a legitimate scientific research topic, if it develops the technical or conceptual basis of the tool itself. They contend that where GIS is used as a tool for investigating a research issue, then this *does* constitute the practice of science, but that the tool exists separately, while science proceeds independently of the character of the tool. Pickles (1997) responds to this by challenging the artificial division between science and technology, as discussed in section 1.2. In line with Pickles’ account, although interviewees in this study were using GIS purely for applications, they did not appear to differentiate between the utilisation of GIS technology and the practice of science. Rather, they tended to contextualise their practice of GIS within the discourse of Western Science, and the structures of status and credibility that are invested in it.

Although Wright et. al. (1997) briefly direct their attention to the problem of defining science, suggesting that it encompasses a wide range of fields, which differ in philosophy and methodology, they draw most extensively on the classic model of science. Defining science as “a shorthand for a logical and systematic approach to problems that seek generalisable answers”, Wright et. al. (1997: 353), suggest GIS, as a scientific practice, is characterised by rigorous data collection and precision. This enables geographic spatial concepts, such as connectivity and adjacency, to be applied to the model, and therefore results in verifiable analysis. Geographic information science is thus concerned with “the primitive elements [of points, lines

and areas] used to describe, analyse, model, reason about and make decisions on phenomena distributed on the surface of the earth” (Wright et. al. 1997: 357). Precision thus becomes the basis through which these “geometric primitives” provide a GIS model of materiality, upon which objective analysis can be performed. Objectivity is achieved by analysing ‘precise’ GIS data with a systematic methodology, which produces verifiable and repeatable results. This section focuses on the way in which interviewees in this study adopt this rhetoric, invoking both notions of precision and objectivity, as they situate GIS within scientific discourse.

Interviewees in this study generally considered themselves to be scientists, often having first and postgraduate degrees in scientific disciplines, such as biology, geology and specialist environmental fields. Although there was an enormous variety of tasks undertaken by staff,¹⁶ the emphasis on providing scientific advice was a prevailing theme:

“the computer should be able to tell you what **exactly** that proportion is, so **it'll give you a fact to back up what previously would just be a statement**. [Instead of saying] this represents a high proportion ... of unimproved grassland in West Lothian, ... you would then be able to say this represents 23% of the unimproved grassland in West Lothian ... it will be able to **factually back up a thought process** or an analysis of data”.

Melanie

“it's really the Scottish Office at the end of day who make decisions, so ... **they need ... back up... scientific information**, ... really the reason for doing this is to decide what the boundaries should be, and which tributaries should be included or shouldn't be included ... I think it's more or less the decision ... that Spey is going to be chosen as a SAC. It's just proposed at the moment, but at the end of the day - **it's got to be seen that the actual data has been looked at**”.

Joe

Joe describes his responsibility in terms of providing the Scottish Office with information which is explicitly grounded in scientific practices. The emphasis here is not so much the utility of GIS' analytical functionality, but the appearance of rigour it provides. Interviewees frequently allude to the need for such an approach, which provides categorical and consistent answers, which, for example, through the use of statistics, allow one to “factually back up” a decision, and therefore provide an answer which is defensible empirically. Prompted by various contractual and legal

¹⁶ E.g. Identifying areas for designation, such as SAC; MNRs; wildlife reserves etc., responding to planning proposals, managing change in SSSIs, representing SNH in public enquires etc. For a fuller account of SNH's role and responsibilities see section 2.2.1.

obligations to provide unequivocal answers on issues which are frequently controversial, interviewees exploit a language of reason to make their arguments *appear* indisputable, and thus science is invoked as a powerful and persuasive discourse.

For the interviewees, establishing accuracy, through precise and rigorous data collection and data modelling, enables objective analysis, and provides the basis of 'rational' decision making. This process is pivotal to their understanding of the construction of scientific fact, and thus, for them, GIS is embedded in the Foundationalist project. Foundationalism, as envisaged by its founding fathers, such as Descartes and Locke, suggests an unproblematic and singular reality, where the processes of observation, description, inference and finally theoretical elaboration, provide insight to rationally grounded truth (Livingstone 1995). The interviewees in this study often locate GIS within the realms of this materially accessible and singular world, relying on a concept of spatial ordering, where the world is understood as a series of discrete objects, located precisely in space, which variously interact and relate to each other. This notion of unproblematic 'real world' space is underpinned by the historical construction of Cartesian space: which is based on the assumption that space can be understood as three infinite axes at 90 degree angles, which divided into discrete quantities, provides unique co-ordinates relating to specific locations in the material world. As a method of ordering and viewing space, it relies on the separation of subject and object, suggesting that an object can be identified and located precisely (Roberts and Schien 1995). Embedded in Western socially constructed ways of knowing, it cannot possibly reflect a naively given 'real world'. It does however provide a framework in which the world can be understood, and provides a basis for the construction of 'rational facts'.

Within GIS, this assumption of discrete entities located in Cartesian space renders precision compelling, as the degree of exactitude is intimately related to how accurate and useful the GIS model is considered to be. Thus for Nigel, the lack of precise data becomes a significant problem when he is attempting to establish whether SNH should object to a proposed development or not:

“you do need quite a lot of precision for it to be really useful, ... other wise .. there's something in that 1 km square, where's it likely to be? ... you might then go to a Phase 1 habitat map, OK, the species is likely to occur in a wet environment. There's a bit of marsh in that corner, it's probably in there, the development's on ... dry ... we're probably OK, but it requires a bit of interpretation ... but if you've got 6 figure grid refs. But you're not going to have that for every plant are you?”.

Nigel

This theme is echoed by others:

“it's quite important to be able pinpoint where things are happening.... so that's one of the prime reasons why I want to be able to use a GIS system”.

Donna

“the map and the description are actually legal documents ... so they have to be precise”.

Bill

The GIS is perceived not only as a tool for facilitating the management of data, but as a means of accessing a transparently knowable ‘real world’, where the act of accessing the data through the GIS image is conflated with the process of understanding the material world. Thus Nigel’s assertion that interpretation is necessary because of the lack of detail in current data sets, seems to imply that the precision afforded by six figure grid references would render the data both unique and concrete. Rather than relying on his subjective interpretation, a perfectly precise image of the ‘real world’ would interpret itself. This understanding of GIS is based on discourses of masculinist science, as discussed in section 1.2, where truth claims are presented as credible precisely because they are disembodied. The implication here appears to be that the GIS could accommodate a perfect model or representation of the ‘real world’, providing knowledge outwith the perspective of any situated subject.

This construction provides a supposedly “inarguable” basis from which to perform analysis, as the degree of completeness and precision of the model, confers rational status upon decisions based on it. This notion is adopted by Charlie, as he attempts to settle a dispute concerning which habitat is important to a protected butterfly by performing an overlay on the butterfly and habitat coverages:

“I was having a dispute with people about which was the main habitat for this [butterfly], and so what I did was to ... get all the spots on as a cover for the species of the butterfly, and then say, well what land cover does this spot fall on? ... Sally¹⁷ actually got the

¹⁷ Sally is part of the Local GIS Facility (LGF): the department within SNH that is responsible for maintaining and developing the GIS system, and supporting users. For a fuller account of the LGF, see section 2.2.3.

ArcInfo to classify them all by the LSC cover,¹⁸ which was nice, well it served the argument anyway”.

Charlie

For Charlie, the utility of this precise model is its ability to represent butterflies as points existing in discrete locations, and relate them to spatially delimited habitats, delineated by polygons in the GIS model. The degree of precision enables him to establish a relationship between the two factors, which effectively renders his analysis an objective truth. Assuming the precision of the model, as an accurate representation of the material world, the overlay rule, determines the relationship between the location of one entity and another, and therefore provides indisputable facts.

As Curry (1994) suggests, like science, GIS is based on a language which is both essentialist and topological. It assumes that discrete features can be isolated, whether they be a piece of woodland, a proposed road or a nesting area for birds, and that the individual elements can then be related to each other. Based on rules, which always apply, this linear scientific procedure renders individual judgement irrelevant:

“The really important thing from my own thing, is **you can take obvious steps back**. If you're presenting simplified information ...and you potentially ... come across ... somebody whose asking very technical, very detailed questions, saying “well what is this based on?” It's not ... that difficult to take steps ... back the line that you've come, to say, **“look, this ... simplified data is derived directly from very detailed survey information**, which I think is ...quite a useful thing to be able to do”.

Pete

Severing the link between the subject and the object, GIS relies on masculinist science. As a type of realist representation, GIS can also be considered an articulation of the Platonic Ideal. It privileges “clean, crystalline, coherent independent forms” that existing in an abstract space, can be related to each other (Penny 1994). For Pete, the notion that a complex technical question can be persuasively answered by identifying the constituents of a analytical conclusion, provides the basis for arguing that his deduction is “obvious”. Thus founded on the procedures of logic and science, decision making becomes the production of self-

¹⁸ The LSC88 cover is one coverage, i.e. a data set on the SNH GIS, which comprises a habitat survey for the whole of Scotland. The 88 refers to the year in which this data was collected.

evident fact. The precision afforded by the technology's naturalised method of ordering objects in space, provides the basis for objectivity.

3.3 GIS and the Visual

For GIS, the visual is paramount. The real becomes accessible through the material, which is itself known through the visible. Pete invites the doubting questioner to "look", to look at the data and see the self-evident facts. In this sense, seeing becomes believing - a visual certainty because the act of looking at the GIS data set on a 14 inch screen is conflated unproblematically with viewing a singular and knowable 'real world'. Thus while empirical observation invokes the visual, the visibility of GIS is exploited to invoke empiricism. The Foundationalist project of reducing the world to knowable objects with observable properties is accomplished in GIS through vision. Based on the assumption that one can only know what can be seen, it develops theory from what can be observed, and thus claims to anchor ideas in materiality. GIS, as a technology of realist representation, thus has the effect of transforming a world of discrete physical entities into facts.

The credibility of GIS therefore appears to be based on a modernist rejection of metaphor, where the GIS itself is held to be not a "metaphor or model", but a "transparent lens to true meaning" (Cosgrove 1990: 350). Sarah implies this as she recounts her pleasure in discovering that the system can record spatial and attribute data together, dispensing with the need for two data management systems:

"I knew that **you could go out and survey pieces of ground into a computer**, and you would get a contour map out of it, but what I didn't know ...our GIS system stored stuff ... in databases ... and that to me is ... excellent, because it means that you're not doing something twice".

Sarah

Sarah suggests that one can actually survey pieces of ground into the computer: the space (and objects contained therein, represented in databases) becoming seemingly interchangeable with their representation. Unlike digital cartography, the GIS is powerfully flexible, because its mimetic qualities are supposedly comprehensive. Representing not only the observable dimensions of objects in the 'real world', it is able to record their observable properties, and within a Foundationalist framework,

where objects are reducible to such, it cannot be properly understood as model or metaphor. As Cosgrove (1990) argues, within the modernist project, the notion of metaphor is rejected, and GIS becomes a seamless reflection of the 'real world'.

The technology provides a panoramic view of the 'real world', and where the GIS image is considered to be a perfect representation of material reality, it offers the user a uniquely powerful position. It is a panoptic view, allowing scrutiny by the remote operator, in a conceptual move which renders space Cartesian, rather than lived (Curry 1995a). It is also one of infinite possibility, for unlike the 'real world', the user is enabled to alter it with ease. This possibility is recognised by both Laura and Sally when they consider the utility of GIS in responding to proposed road developments:

"[what] they want to do is to put a road through the site, and we would have had to plot the road on some way, and obviously having GIS, we'll be able to say to them ... this is **part of that system**. It gives it more credibility because obviously it's been done accurately rather than us ... having to try and draw in on top of our map this route where the roads go. So it's given it more credence I think all together, to be able to use the system on this bit of casework".

Laura

"I was looking at it from a planning point of view, and I was thinking, that was great! **You could put a new road in there and you could see where the damage is going to be done, you can see this and that**, and rather than bring maps out and sit with a pen and paper, and say ... "where's this?", and plot stuff, you can see it".

Sally

Both Laura and Sally emphasise that when inputted into the GIS, the theoretical road becomes "part of the system," and is therefore solidified: made real. The boundary between the solid material world, and a virtual one of ethereal shapes and objects, seems to dissolve. It is the accuracy of the model, and its resulting intimacy with the 'real world' which validates its predictive capacity, and it is this interchangeability, which renders looking at the GIS image, (as opposed to merely drawing it on a map, which falls short of that intimate connection,) the same process as building the road in the 'real world'. The visual here is paramount: the GIS image is so persuasive that the consequences unfold before the infallible eye of the technology. Assuming a seamless connection between the image and reality, Sally is able to "see" what damage would be done in the 'real world'.

Drawing on such interpretations of the 'real', interviewees tend to consider GIS as a framework for viewing data which provides total coverage, and therefore as a primary methodology on which to base decisions. Conflating the GIS image with material reality, vision becomes a privileged way of knowing, for it is assumed that what is seen is really there (Roberts and Schien 1995), and inversely that anything that is really there, can be seen, represented and related to others 'real' objects:

"the Area Officers out in the field would be able to ... have a map of the areas within their site, and hypertext, and flick up so **they could get a description of ... whatever they click on, what it was, and how it's related to everything else**".

Danny

"I think **anything can be mapped** if you throw sufficient money at it".

Gary

"a lot of the data that we ... use is the data that's been gathered already by British Geological Survey, so ... **they've mapped just about the whole of Scotland**, so as a geologist we know where all the rocks are, ... it's quite handy. We're probably in the best position in that respect compared to the biologists, because they don't know where everything is, [the geology has] **all been mapped, it's down on a whole ... series of maps, as to where all the rocks are and what they ... represent**".

Jaik

"so if it moves up there, even if it doesn't move, quite often, we collect, we record it, ... people and things like that, so we know about how recreation affects them, for example".

Colin

These quotes express the notion that data about the environment can be collected and presented in a totalising way: where each successive layer is viewed as "a piece of the jigsaw" (Simon). The object is mastered through the process of being observed, and "knowledge becomes a matter of accumulating facts in order to appropriate objects" (Slater 1995: 221). Where no data (no activity, no object, no space) are beyond the gaze of the machine, the strength of GIS becomes its ability for perfect vision in its provision of concrete data.

In this sense, GIS provides a view from above. It relies on a remote or detached view of the material world, where passive disengagement allow an all-seeing operator to view the world impartially (Veregin 1995). Anne invokes this image when describing the benefits of GIS for surveying a site of a proposed development. Imagining the differences between doing this with GIS, rather than a field visit, she suggests:

"it has a potential to be a leveller in terms of how things are argued.... all statistics, which is what GIS is really, it's just co-ordinates isn't it, it's statistics in another form, they can be

manipulated, but I think they're probably more - solid in their foundation of objectivity, if there is such a thing, than the way in which we hand appraise or ... consider things by field work only, and personal view of the field workers whose done the assessment ...

"Can you see it from here or here?"... where as if **you just shovel data through a computer** it will tell you whether you can or not within ten metres, and all over the area, not just from the road, and not just from the route that they've walked, but ... the whole area can be considered, y'know, the pixel of the thing, rather than the field worker going out and walking round saying "where can I see this thing from?".

Anne

GIS provides a totalising and standardised way of viewing the world, which conveys the gift of the god trick – 'a god's eye view of the world' - onto the operator (Haraway 1985). The eye becomes the point of contact through which objects are engaged, and all other senses seem to be marginalised. The subjective or personalised opinions of the (highly skilled) fieldworker compares imperfectly with the GIS, and it is the eye which appears to propel an otherwise disembodied user. Constructing GIS as a "leveller", she initiates an appeal to the democratic qualities of empirical science, and as Rose (1993) argues, this disembodied gaze is enacted to separate the mind from the body, and preserve objectivity. This retreat to a critical distance is an issue to which I will return to in section 3.5.

The possibility of perfect representation, through precision and objectivity, are exploited to construct the machine as impartial. It is suggested that it merely represents what is actually there, so that the distant user is able to form objective decisions from the pristine position of perfect vision. The process of inputting data is reduced to the crude term of 'shovelling', and the complexity of the way in which GIS deals with data, and the problems associated with it are erased. The machine seems to develop a sense of autonomy - it tells you the answer - and there is some sense that the imperfect human is competing with the impartial, all seeing/powerful machine. The notion that the data have actually been shovelled in by an imperfect human isn't apparent - and although the shovelling implies a 'shoveller', the process is trivialised by this metaphor of unskilled labour into insignificance. The power of GIS stems from its ability to produce a manipulatable world comprised of bits of information, and the promise, at least for the GIS operator, of reconstituting them into objective fact. As Curry (1994) suggests, the image of complexity and sophistication surrounding this technology belies the most simple practice. For it is

the notion of accuracy, based on theoretically naïve conceptions of precision, which form the basis of totalising vision and objective decision making.

3.4 GIS as Magic

“we haven’t had to [defend in a public enquiry] so far using GIS, but there’s several cases where ... we might have to very soon, and ... I’m sure it would help in that. You just produce some fancy pants slides on Powerpoint, and then you’ve got some humble crofter, or some ... poor guy from RSPB, who doesn’t have access to ... any **fancy** gear, and produces this hand scrawled maps, where as SNH produces these **all singing, all dancing displays**, even though it’s probably meaningless, and hope it carries the day”.

James

James’ view of GIS appears not only to exemplify the concerns of those who have criticised it for marginalising the interests of certain sections of society (Onsrud 1995, Crampton 1995), but it also appears to contradict an understanding of it as a scientific method, whose validity is grounded in accuracy and objectivity. Instead, James seems to suggest a GIS more akin to a side show, where a “fancy” production captivates the audience. Yet if as James admits, such “all singing, all dancing displays” lack scientific meaning, they certainly possess visual clout: their effectiveness being intimately linked to a very visible performance. Slater (1995) suggests that where seeing is based upon believing, technologies of modernity must produce spectacles as proof. Modern science has historically relied on dramatic and spectacular displays, such as public demonstrations of scientific laws which literally produce flying sparks and audiences gasping in wonder. Arguably the spectacle of GIS is a continuation of this tradition.

Certainly the utility of GIS for producing visual display is explicitly recognised by the interviewees, especially when it is essential to persuade others.

“we’ve used this approach in public meetings to use maps generated directly from the GIS, make them into slides, stick them up ... on the screen in front of an audience of what we call relevant authorities, which is the management bodies and local people like the fisherman, local interests, and say **look, this is what it’s all about, this is the interest of the site, isn’t it wonderful?** This is the map that we’ve come up with from, for where these habitats are, this is the best information that we have about the activities, and if we lay one on top of the other we can **see, look**, rather than there being whole scale conflict you’ve actually only got a very small area of conflict, and it’s actually been a powerful tool”.

Pete

“to be able to **show to people** that there are interactions, cos one of the things about coastal zone management ... is to **show people** that there are conflicts going on out there,

and [GIS is] a **perfect** way to do it ... you can show dolphins feeding off the end of outfall pipes or something like that, and it's **perfect, it's just right, it's just what you need, it's just brings it out in sharp relief**, y'know, what the problems are".

Rose

This process of persuasion is visually orientated. Seeing becomes believing, and the other bases for objection are swept away. However, clearly there are two processes operating here. At one level, the transparent link between the 'real world' and the GIS model is enacted, so the process of viewing data on the screen is unproblematically conflated with the observation of 'real world' phenomena. At another level, GIS draws its credibility from an element of wonder. The demand for the fisherman and relevant authorities to believe what they see is predicated on the technical power to produce convincing spectacle.

These two processes are however intertwined, for the wonder is based on the realism suggested by the model, while the realism – the willingness to be seduced by the representation – exists through the technical sophistication of GIS. That is, it is the element of spectacle that encourages the onlooker to suspend their disbelief, while their awe is predicated on the notion that they are viewing an image of the 'real world'. Laura illustrates this process, as she explains the utility of presenting GIS generated material to a group of commercial developers and architects, who are planning a major development on a site used as a breeding ground for Hooper Swans:

"I think to ... go through people's ... either field notes or the written texts on the birds, it isn't all that technical, but it does sound quite trivial in many ways ... it says six birds were preening here, and ten birds were feeding there, if it's ... **shown on a map then I think it's, well maybe they, I think they find it more important, it doesn't sound quite as trivial to them as [laughs] they certainly reacted better to seeing all the information we had set out on ... a map**".

Laura

"strictly speaking ... for the questions they wanted answered, we could have probably have done it without the GIS, but I think .. **you can illustrate things** quite a bit better, and I think **the fact that it's on a GIS made it all look a bit more as if we'd got into it systematically**".

Peter

Laura hesitates and laughs as she searches for an explanation as to why the GIS produced documents were more credible. Like Peter, whose application entailed defining and justifying an SAC boundary, she is not suggesting that using the GIS made any difference to the data that was used, or necessarily to how it was analysed. The GIS relies solely on the same "trivial" data that was collected by the recorders,

but by providing a technically opaque interface between them and the audience, it instigates a more dramatic performance.

The spectacular qualities of the GIS are based not only on its ability to explain the 'real world', but on its own inexplicability. Thus while interviewees are often eager to contextualise their enthusiasm for GIS within its data management capabilities, their descriptions also rely on a sense of pure awe:

"if you take 30 years of records for a dozen islands for a dozen species that's a lot of records ... so having, .. that sort of information on GIS, it would pull that up on screen, and play around with it, to pick out certain species, or compare certain locations for one species or more than one, **it would be wonderful**. At the moment it's all on bits of paper through different files, and it's a **nightmare** ... I'm vaguely aware that it, potentially .. a powerful tool, I've no idea how it actually works, or .. any of the technical bits, but I'm just aware that ... it can potentially do an awful lot".

Nigel

"if we had a national data set and we wanted to be able to say, OK, where are the best areas, give me any area where there are more than x numbers of any particular feature that you're after, and it could pum, pum, pum, pum, y'know, great, **that would be wonderful**".

Colin

The attention of users is captured with a kind of open eyed wonder, where GIS impresses them, partly because, like Nigel, they don't understand how it works. Both Nigel and Colin exclaim that "would be wonderful", and GIS becomes the dream, which for Nigel at least, is presently the nightmare. Their enthusiasm for GIS appears to be predicated on the possibility of not only being able to access 'reality' through the GIS, but on their wonder at the incomprehensible technology that makes this possible.

Slater (1995), in his study of early photography, suggests that the representationalist technologies of modernism are akin to magic, where pleasure is derived from the invisibility of the illusion. Realism is used as a vehicle to transcend the real: to produce magic from what is known to be the accomplishment of science. He terms this phenomena 'natural magic' to distinguish it from the pre-modern belief in supernatural forces. Natural magic denotes a technique which is used to simulate a magical effect. The audience is aware that there is a rational explanation, but nevertheless, is in awe of the illusion, while the state of wonderment stems from their inability to understand how it is done. For users of GIS, this process seems to be operating:

"you can do it really quickly within GIS, and bump, you get your results straight away on a map, and it's great in that respect ... but ... that's only a small area of what the GIS can do, but it's ... an area that I've looked at a little bit".

Pete

"I sent down the way I'd tabulated the information, they made a few adjustments to it, and sent it back, which made it work, and I haven't been, I wasn't far out, it was just one or two minor, minor things, and that ... made it work, and **it all sort of appeared on the screen like magic, which was very pleasing**".

Joe

The enigmatic GIS seems to occupy a site of magic and mystique, so that for Pete the processing of results by the system is reduced to a mysterious "bump", like Colin's "pum, pum, pum", while Joe's data appears on the screen "like magic". Clearly there is an element of fascination in seeing something clever or potentially amazing happen on the screen before your very eyes, especially if the user feels they have contributed to that process. The magic clearly produces pleasure through this gaze, which seems discordant to the discourses of science and objectivism, which are more usually associated with GIS (Rose 1992).

The realism of the GIS thus becomes both a tool of science and its spectacular outcome. While the GIS image is presented as a seamless reflection of the real world, it is the wonder associated with such spectacle that enables it to be credible. For GIS then, its technical accomplishment is not only to provide knowledge about the 'real world', but to produce plausible illusions. The image may be based on denotation, but it rapidly becomes connotation, that is, the signs which initially represent material phenomena are naturalised. By providing a credible image, it encourages consumers of GIS to suspend their disbelief, and the model becomes more than just a representation, but a part of the 'real world' itself (Slater 1995). This process is aptly illustrated by Laura and Sally's comments above regarding GIS' utility in considering road proposals. In suggesting the solidity of a proposed road, the GIS model does not aim to provide knowledge about the 'real world', but to provide a plausible illusion. Sally's assertion that the GIS enables one to witness what damage would be done is therefore a flight into a fantasy world, where the visual image no longer has any reference to the position of an observer in the material, optically perceived world (Crary 1992, Jenks 1995). So GIS, as a modern vision, occupies an ambiguous position. Its reliance on detailed realistic

representation is supported by a belief in wonder that appears oppositional to its aims. Like photography and other modernist representational technologies, it seems “to re-enchant the world through natural magic, rather than to demystify it through objective vision” (Slater 1995: 236).

3.5 Tensions between the GIS image and material reality

“when it comes to the practicalities of having a document which is robust enough for people to understand, then **we would tend to go more for something which was fac..., is more, is not so subjective**, ... if you think of a moorland ... if you took one person, stood them in the middle of it, they might describe it as exciting and relaxing or whatever, other people might actually feel, I hate this, I'm too exposed, I'm too cold, I'm scared, so you've got actually the same landscape, and the written description of it would be exactly the same, but how people perceive it is really your own personal experience, and we try and take these two elements apart if you like ... so that if ... we have to defend a decision, we are reliant on the scientific approach, how people feel about it then, they can make their own minds up, so it's a slightly different emphasis”.

Sarah

For the interviewees in this study GIS seems to lack stability. At one level, the demand to believe what one sees is delicately balanced on the ability of the technology to produce convincing display. At another, the scientific approach, embodied in the practice of GIS, is valued as a means of constructing defensible truths, even as objectivity is simultaneously denied, as interviewees fail to completely embrace this scientific paradigm. So Sarah, recounting the need for objective data, while recognising the importance of the subjective, establishes a tenuous dualism. In juxtaposing the two terms, she explicitly suggests that the fieldworker can separate objective and subjective data. It is however difficult to know how the identical written descriptions have been constructed, when they appear to have been produced by fieldworkers who she acknowledges are subjectively differentiated, and if the descriptions are indeed the same, how such reputedly objective data might relate to the experience of that moorland. Sarah seems to acknowledge this as she hesitates over the word “factual”, and even as she invests status in the objective nature of the scientific approach, by her own admission, it is merely “not so subjective”. The definite distinction between subjectivity and objectivity cannot be effectively pursued, and if, as she claims, the “two elements” can be taken apart, the distinction appears to remain blurred. This appeal to science,

which purports to provide a coherent and self-evident argument, therefore also hints at the tensions in the structure.

The limits of the discourse thus echoes through the language of reason that interviewees exploit. So for Anne, the scientifically viable argument suggested by her “sophisticated DTM GIS” at the beginning of this chapter, is limited, because it is partially tainted by error. She admits:

“it was very persuasive, because it was based on data that was inarguable. It was OS based, OK, **there was a limitation, it has a degree of error**, but that was declared, what that error was, and it helped our ... cause a lot”.

Anne

She suggests that the data are simultaneously “inarguable” and arguable, that is, containing error, while its contribution to her case is presented in much weaker language than her forceful endorsement of the technology’s usefulness. Similarly Melanie’s firm commitment to precision, which “provides a fact to back up what previously would just be a statement” (quoted in section 3.2) is contrasted by her assertion later in the interview that:

“[the statistic is] only as accurate as the data inputted, and we’ve already found that there are problems with the accuracy of the original data, so, although you do get a more factual answer, it’s still not the truth as it were **to me it doesn’t really matter whether it said 29 or 27 percent, it’s still ... would be a large proportion**, but it gives people a greater idea of ... your description”.

Melanie

The notion of a “more factual” answer seems to contradict the rhetoric of precision and accuracy which is used to justify GIS methodology. These tensions are pivotal to a discursive understanding of GIS, and require the most careful consideration. To unpack the intricate connections between truth and power, it becomes necessary to explore the relationship between GIS, the operator (or knowledge seeker) and the ‘real world’ in greater detail.

Despite interviewees’ tendency to conflate GIS with the ‘real world’, there is also a propensity to argue that there is *no* substitute for the decision maker actually experiencing the ‘real world’ itself:

“I can’t really say whether [GIS] is likely to reduce the amount of site visits required, and I’m not necessarily sure that I would want it to, because, well certainly not ... if you’re new to a site, if you’re new to area, then there’s no way ... that you would do it all on paper and not go out to the site, and if any of my team members were doing that, then ...

I'd have something pretty serious to say about it **if you don't know the site then there's no substitute for going out and looking at it**".

Judy

"you just go out, and at least visit, **if you've never been there before, go out and just walk around the site, just to get the feel for it**, and to get the feel for ... the age and condition ... of the woodland or whatever it is, whatever habitat, cos you've probably got maps and things, but you never, it's - **you try and get out to visualise it**".

Nigel

In some respects, the notion that it is necessary to 'look' at the 'real world' in order to understand it more completely, supports the Foundationalist premise that the act of viewing may be conflated unproblematically with the concept of understanding. Yet this is incompatible with the notion that the perfect representation provided by the GIS does not afford the same opportunities as the 'real world' itself. These accounts also retreat from emphasising the visual: Nigel suggests that he has to "walk around the site" and "get the feel for it".¹⁹ Although such statements are usually presented as self-evident, when pressed to justify this view, interviewees occasionally exploit 'rational' arguments: suggesting that there are limitations to the ability of the GIS to imitate the material world.

They argue that a range of technical and practical difficulties affect the completeness of the model, and it is asserted that this limitation necessitates site visits. Often it is impossible to achieve desirable levels of precision for a range of pragmatic reasons. The expense associated with collecting marine floor data, for example, leads to surveying being done on an indicative basis only, compounding any inaccuracies inherent to the original survey methodology, such as misidentification of species. Similarly Area Officers recall vegetation surveys where you are "lucky" to get a dafor rating²⁰ for a particular species, and precise mapping is rendered impossible, because you can't plot every primrose, daffodil and oak, and even if you did, it would change constantly. Even when data are available, that is currently in hard-copy files or existing elsewhere in digital form, sometimes it is not possible for them to contribute to the completeness of the model. Like many GIS implementations, SNH has been unable to afford small scale digital OS mapping,

¹⁹ This issue will be explored later in this section.

²⁰ A dafor rating is an ecological index of abundance for a plant species, used to describe whether the species is dominant, abundant, frequent, occasional or rare.

while the labour intensive nature of data input has made it impractical to mount many current hard copy SNH data sets. So even where 'imperfect', 'provisional' data exists, it is beyond the scope of GIS.

The notion that it is "people on the ground" who know what is *really* going on, and are able to gain insights not available in the GIS model is however also prevalent:

"I think probably people like them, you'll get the most resistance from, these out lying small offices, you might get fortunate I mean because they're the people that are right there with y'know, they have management over the data, **in respect of real terms, they're, they're out there, they're where this data exists, to people here it's just y'know numbers and polygons**".

Terry

"I didn't know anything about peatlands at all till I started here, and so all the things I know about peatlands are just things I've picked up on the way, and I have tried to pick up as much as I can, but I, **there's only so much you can do without going out into the field, and standing on the stuff**".

Duncan

"with all the investment that we're putting into GIS, there is a question as to how much of a balance needs to be struck with **people who are out there on the ground who know what's going on**".

Gary

Such statements imply the importance of a far more direct relationship with the 'real world', which moves away from a singular world of discrete objects located precisely in space. So for Terry - an enthusiastic champion of GIS - the 'real world' does not seem to be reducible to "numbers and polygons" after all. Yet it is difficult to comprehend what these interviewees are alluding to in these comments. Why does Terry envisage that the data is more real to someone who has actually been to the space in which it exists? What does Duncan - an office based GIS technician, who has no (formal) ecological expertise - expect to achieve by "standing on the stuff"?

The distinction between the GIS image and material reality suggested by these interviewees, could be interpreted as a binary distinction between the GIS image and the material world. This differentiation challenges the mimetic quality on which, through precision and accuracy, it is positioned as a seamless representation of the 'real world'. It seems however, that whatever qualities experience in the field has to offer, they are more difficult to articulate and justify within the constraints of a language of reason: a factor which seems to influence Gary's concern:

“the people who have the purse strings of the organisation, say that ‘Oh, we’ll put all this money into GIS, it saves going out and doing the job and all that kinda stuff, they can do it all from their desk’..... you can see that there’s maybe fairly persuasive arguments from the top end of the organisation to say: ‘well, you’ve got all the information there, at your finger tips, in your desk, in your office. Is there a need to go out and do anything more when you can ... use GIS, you can use databases, use whatever?’ , but er.. **you do need to get out there, and you do need to have people who know the lay of the land, and only so much of the lay of the land can be included within GIS systems**”.

Gary

And even if one supports his contention that only so much of the ‘lay of the land’ can be incorporated in GIS, it sits uneasily on his earlier assertion, (section 3.3), that absolutely anything can be mapped.

The notion that the image might provide a substitute for embodied experience is reminiscent of the early history of travel photography. Seemingly neutral and transparent, the photograph was advocated as an alternative to travel, transforming it from a physical experience into a mental exercise. Like the GIS user, the armchair traveller is a detached observer, who embarking on a two-dimensional journey, transforms sites into sights. Clearly however, the views presented by the travel photographer are far from objective: the images chosen reflecting and constructing social practice. They are also productive in themselves, constructing what sites are important, and encouraging travellers to go there (Crang 1997). This parallel is maintained with the GIS image, as numerous interviewees suggest that the GIS data enables them to prioritise in the office, what it is important to see in the field. This suggests that the binary between materiality and image lacks stability. Rather than supporting the distinction between an authentic material world and a mimetic GIS image, they become mutually constitutive, as the image becomes part of the practice through which subjects establish reality. In this sense, it does not exist separately from the ‘real world’, but as an element through which ‘reality’ is created (Crang 1997, Schwartz 1996).

If the material and the image cannot be considered as binary opposites, equally they are not seamless replicas of each other, but possess different qualities. Interviewees may appear to have difficulty articulating what particular elements the

site visit has to offer which differentiates it from the GIS image, but they are clear that it does:

“what ever the paper system or a computer system ... I still don't think it's any substitute for going and knowing what's out there and ... what is where on the ground.... **It's a back up, and it's a very useful backup, and it can refresh your memory as to what's out there, but if you don't how it all ties together on the ground, then ... you could probably misinterpret the data** ... you realise that you had maybe five concerns looking at the data sets, and when you get out there you can actually eliminate two immediately ... **it's just so obvious** that the two that you thought about weren't actually issues to be addressed”.

Melanie

For Melanie the distinction between exploring the site virtually and through a visit is apparently “obvious”. Considering that GIS is constructed as a technology which provides perfect vision, and the ability to relate diverse data entities, the notion that a site visit is necessary to enable its data sets to be correctly interpreted, rather than for example, to collect additional data, is significant. It seems that experience in the field offers a qualitatively different experience, providing the field worker with a distinctively different perspective in which to contextualise data.

Interviewees frequently allude to the importance of gaining such an alternative perspective on the ‘real world’ through embodied experience: a perspective which they suggest isn't easily incorporated into a GIS framework:

“I think people ... within SNH ... were tending to look upon this as a sort of GIS and associated facilities as ... the ultimate in being able to sit at your desk and do all the work of SNH, and basically what myself and others were saying, as far as we're aware at the moment, that's not possible for landscape, and **there is a relationship between the person and the landscape, and you can't ... deal with that in this form**, ... there are times, when you ... **no matter how much information you have there, you will have to go out on site, and you will have to talk to people**”.

Tess

“I think using the system has advantages, but **it's not a substitute for actually getting out there and getting to know the physical environment that you're dealing with**, because other wise there just isn't enough data on the system for dealing with a lot of the work that we're dealing with. A lot of it's to do with how people impact on the natural heritage, what they want to do, how many cows they want to have on an area, what changes they want to make to management, what buildings they want to put up, and these things aren't available yet”.

Kate

For Tess this experience cannot be conflated with what she terms ‘information’, because according to her, it simply does not matter how much information one has, this quality is some how beyond being described as such. Yet if it's not information,

what is it? Perhaps such personal experience is so divorced from that which is normally considered to be data, Tess had difficulty classifying it as such.

Kate had similar problems articulating why there is no “substitute for actually getting out there”. Speaking hesitantly during this part of the interview, she seemed self-conscious about what she was saying, but when her “available yet” proviso, led me to press her as to whether it was simply a matter of collecting more data, she spoke tentatively about different data sets, before concluding, by re-iterating the notion that it was something other than an issue of data sparsity:

‘I think it’s really important in the job that SNH is doing, to still ... go out there and see what it’s actually like - ... and that takes time, and hopefully ... the GIS will help with that, but there are times when you just have to go out and see what something’s like, or you have to go and talk to someone about what they want to do’.

Kate

Clearly her complete picture of the ‘real world’ cannot be contained within a GIS framework, for she seems to be asserting the importance of human relations with the physical world, the aspirations of those related to it, and an understanding gained from particular kinds of experiences. These interviewees appear to be actively rejecting Cartesian space, suggesting a messy lived in space, structured by social relations, which can be only accessed through a range of strategies, which in themselves, re-interpret what constitutes the ‘real world’ (Curry 1995a). In a world where people do not exist as a string of unrelated facts, they appear to lie outwith the remit of GIS’ understanding. Judy also encounters this problem, albeit in a different form, when attempting to negotiate with landowners over management of designated areas:

“with a notice of intent again, [the landowner] might send something in that says we want to ... put a feeding point for grazing cattle at such and such a point, as indicated on the attached map, and quite frequently you’ll find that they don’t actually put it in the right place, or they don’t put it in the place that they’re meaning, cos they’re not ... very used to reading maps or - or associating features on the ground with points on a map, so - these things always have to be checked”.

Judy

For Judy, at least partially, the acknowledgement of shifting perspectives, and the need for such alternatives, stem from a pragmatic recognition that the GIS (or map based model) is insufficient on the basis that others can’t or do not want to conform to its way of viewing the world. This suggests that interviewees, despite their

tendency to exploit the discourses of GIS as a powerful representation that can be conflated with the 'real world' itself, in fact harbour far more provisional notions of how places are understood, and have a far more ambiguous relationship to GIS than an unproblematic adoption of its rhetoric.

It is tempting to interpret the distinctions, that interviewees' make between accessing the material world through the GIS and through site visits, as a tension predicated on gender. It could be argued that the disembodied gaze of totalising vision, suggested by the GIS, constitutes the masculinist position. Separating the mind from the body, this vision is constructed as rational, scientific and objective. Inversely the embodied site visit is situated in different discursive structures, which suggest other ways of understanding the real. The interviewees' insistence that site visits are necessary is discordant with the language of reason that interviewees often exploit to justify the utility of GIS. Instead they proposes a much more intimate relationship between the fieldworker and the 'real world', which interviewees often find difficult to articulate. Their arguments are suggestive of a messy world of lived in space, where complex human relations demand empathy, and the need to connect physically with the site. Nigel's suggestion that he needs to "get the feel" for a site, Duncan's assertion that he wants to "stand" on the peat he studies, and the repeated demand by interviewees to place their bodies in the field all emphasise the importance of touch, which could be aligned with a feminised method of accessing nature.

The disembodied Gaze has certainly been interpreted by feminists as a masculinist way of knowing, where the desire for knowledge is marked by the alleged transparency of the object of study (Haraway 1992, Rose 1992, 1993). Rose (1993) theorises the distinction between the objective gaze of the observer and the transparent object as gendered. She argues that while the gaze of the fieldworker is constructed as masculinist, impartial and active, nature is rendered passive, prostrate and available: qualities which align it to the feminine. Nature, depicted, like women, as vulnerable and fertile, is rendered a commodity, which is malleable to the needs of the (male) spectator. This structure however lacks stability, and the gaze oscillates

between desire and repression. The desire to capture the landscape, to know it completely, echoes the male desire to penetrate a passive and knowable woman, eroticising visual contact with nature. Yet though there is inherent pleasure in this gaze, stemming from the control proffered by total vision, it must be repressed. The desire cannot be allowed to contaminate the rational mind, and thus the eye is detached or disembodied from the pleasures of the flesh. The integrity of objective vision cannot be compromised by the dangers associated with desire, and, through disavowal, the pleasure is denied. The subject refuses to problematise the pleasure wrought from the gaze.

Appeals to both embodied and disembodied knowledge shape the accounts of interviewees in this study. The disembodied eye that propels Anne on her virtual site visit (quoted in section 3.3) is supported by her appeal to the democratic qualities of empirical science. She insists that the gaze is purely objective. Similarly Sarah's assertion that the subjective can be separated from the objective, when the fieldworker responds to a material environment, denies the importance of the embodied fieldworker, even as she invokes it by suggesting differentiated responses to the same object or landscape (section 3.5). The need to seek embodied knowledge and faith in the disembodied vision of GIS clearly shapes the relationship between interviewees, their object of study and GIS, however it does not necessarily follow that the difference between site visits and GIS can be unproblematically mapped onto binary gender categories. The position adopted by different interviewees is not determined by their biological sex: the male GIS technician asserts his need to get out in the field and stand on the stuff, while Sarah and Anne champion a disembodied God's Eye view. This does not necessarily falsify the gender argument, because biological sex does not necessarily correspond with the adoption of gender roles, that is, individuals (of which ever sex) may align themselves with ways of knowing that are usually coded as feminine or masculine (Butler 1993). Nor does the fact that the same interviewees adopt both perspectives refute the validity of this distinction, for clearly, where gender identity is unstable, individuals may move

between differently gendered positions. The gendered ways of knowing would continue to be discernible.

Significantly however, there is no evidence that the interviewees experience different methods of data collection as gendered. There are no references to Mother Nature: the landscape is not feminised in their discussions, and the gaze is not presented as overtly masculine. Nor, as the reactions of Sarah and Anne exemplify, is the demand for perfect vision confined to views through the GIS, but is also discernible in the field. To adopt this gendered perspective uncritically thus holds the potential danger of re-enforcing the very dualisms that recent feminist theorising has endeavoured to disrupt. The association of objectivity and rationality with the masculine, and of nature, empathy and touch with the feminine, is not a reflection of truth, but of how these objects, qualities and gender itself has been constructed (Keller 1992). Although interviewees do make a distinction between experience gained through the field and GIS, to suggest that these are distinctly gendered would only serve to essentialise the categories of male and female (Fuss 1990), and to deny the grounded experience related in these interviews. Dualistic gender structures, in this particular instance, cannot be mapped unproblematically onto the experience of data collection.

3.6 A productive tension?

The tension between the GIS image and the material world is however an important one, which is recounted consistently by interviewees. Questions concerning how this tension has developed, and its effect on relationships between users, the 'real world' and GIS, continue to be germane. That this tension is embedded in interviewees' understanding of the technology, prompts the question as to whether it should be perceived merely as an inconsistency on the part of GIS users, or alternatively, that it constitutes a productive tension, which enables users to establish and maintain complex relationships with both GIS images and material reality. This section will address these concerns by examining the factors that

contribute to interviewees' often ambivalent understandings, as a means of accessing what effect these tensions may have.

In some respects the notion that GIS images cannot be conflated with the material world seems to stem from interviewees' experience of managing 'real world' data. Richard's research into the Marsh Fritillary Butterfly, for example, emphasises the importance of the visual in identifying breeding grounds – a verification usually associated with objective data collection:

"in the flight period ... when the things are flying around, they're a lot more visible, so we actually wander round and actually try and find where the populations are and then ... find out where the things actually are, you find out where they're flying around, then we ... identify those ... areas, and then come back in the Autumn and then actually count the larvae webs in September the webs are quite visible and you can wander round and actually count the webs".

Richard

Yet he is also aware that such visual verification is fantasy. The survey is merely indicative: based on the subjective feelings of the recorder:

"our recorders actually use two letter, six figure grid references ... but we've got to realise that ... they're trying to give a grid reference for the core of the colony ... you have to take into the account the fact that it's done on the basis of ... where they feel the core of the colony, ... rather than this is where the colony is, you don't get it outside 50 metres, 100 metres of this particular spot or whatever, so ... that's the sort of problem that we have".²¹

Richard

Despite interviewees' acknowledgement of the need to produce definite answers, there is general consensus that the objective processing of information is no more than myth, and that data about the 'real world' is provisional and partial. The 'real world', as experienced by interviewees, appears resistant to the gaze of an observer situated within Foundationalist discourses, while much of the 'scientific data' that draws their interest is not malleable to this technology's Cartesian version of spatial understanding. This creates an interesting tension, because although the visual is valued as a means of accessing 'reality', the possibility of rendering the data visible to perfect understanding and perfect communication is simultaneously rejected. The visual is therefore simultaneously supported and rejected. It constitutes a means of accessing the 'real world', and providing a source of data to construct GIS' totalising

²¹ It is worth noting that this isn't an issue of scale. The difficulty arises from the inability of the recorder to precisely identify the colony on the ground.

gaze, while it concurrently disrupts the illusion of total vision, because in contrast to the Foundationalist assertion, perfect description does not follow observation.

The gaze of the surveyor is not one of total vision, but of partiality. The view that is presented in the data reflects the individual fieldworker's field of vision and subjective judgement, rather than materiality itself. Partially this results from the inability of Euclidean geometry to ever provide a totalising view. The realist illusion of translating a three dimensional space²² into a two dimensional surface has the effect of rendering form and position relative, rather than absolute, and as the image constructed varies with distance and angle, it produces vision from the perspective of a single eye. It is an eye that controls the view of the observer and frames the 'reality' revealed (Cosgrove 1985). The eye of the detached observer is by definition outside the field of vision, and thus looks from a point of invisibility. In the GIS data set, the surveyor is allegedly erased, and space is appropriated by the detached observer, through the illusion of geometry's total vision. Though as Crary (1992: 5) convincingly argues, "vision and the subject are inseparable from the possibilities of an observing subject", who is produced through the practices, techniques and institutions through which they are subjectified.

Richard's difficulties stem also from GIS' unproblematic adoption of points, lines and polygons from cartography. Embracing these concepts uncritically, it has failed to acknowledge them as abstractions which were originally intended for display, rather than analysis (Veregin 1995). From an analytical perspective, points, lines and polygons are arguably only appropriate for mathematically defined areas, such as census tracts or postcodes, and provide a poor conceptual framework in which to comprehend and classify messy natural phenomena. Despite the notion that all objects can be identified and located precisely in space, the phenomena of the natural world appear resistant to this. The notion of precision is integral to the functionality of GIS, as spatial location is fundamental to relating entities to one another, and thus to the promise of total vision. Where an overlay, for example, is

²² Clearly there are always four dimensions, as data is collected at particular times. This is an important variable to users, who are often collecting data that varies seasonally and from year to year.

attempted on several data sets which are imprecisely located, the error is compounded, and the operator is able to producing convincing maps, which apparently show the spatial relationship between the various variables, but which may be, as James suggests in section 3.4, “meaningless”.

The difficulties inherent in mapping ecological data form an on-going theme in the interviews:

“Peat is a very difficult thing to measure as far I can tell, in that it's - there are different ways of classifying, of actually trying to define your bogs ... do you go for peat that is obvious from the surface or obvious from its vegetation, or do you try and find peat that is deeper than one metre in depth, in which case you need to go out and do a site test, and I think that the estimates of how much peat there is in Scotland do vary a lot”.

Duncan

“[this habitat map is] not actually divided..... there's no actual boundaries put on it, I mean I've walked through this wood myself, and it's just that ... you can't even say OK, this bit's ending and now I can describe it, but **I couldn't draw a boundary between that bit and that bit,** so ... this is a slightly unusual one, often you do get more precise boundaries drawn on the map, it just depends, but then ... somebody else might have just lumped all of that into one, and written a broad description for that large area”.

Nigel

“obviously Eagles are a wee bit different to plants, y'know you can't be that precise”.

George

“as far as fish and things like that are concerned it's very difficult, and I deal with species like that which are, **it's difficult to know what information to put onto a GIS”.**

Richard

“the Dottrel²³ for example depends on where it is, on what time of the year you go out when you survey, as to how good your results are, so we had to ... put in .. a quality thing on that ... you put on a different calibration, a different correction factor as to how many were actually there, so we did that as well with all the data”.

Colin

In this sense, there appears to be a disjuncture between the need for a systematic, scientific approach and the acknowledged impossibility of collecting information about the ‘real world’, which is anything more than indicative. So Colin’s account of using the GIS contrasts sharply with Anne’s virtual site surveying, (quoted in section 3.3) where the subjective and personalised opinions of field workers compare unfavourably with the all-seeing GIS. Here imperfect people abound: collecting data of varying reliability and calculating different correction factors, while the GIS is allocated a less autonomous position. GIS is no longer presented as telling one the answer. In fact, even though Colin is speaking about his operational system, its

²³ The Dottrel is a protected species of upland bird.

existence is only implied. It seems that the illusion of the totalising gaze of GIS can only be maintained in a space outwith its actual utilisation.

Given this complex interweaving of deviations from that longed for lens to true meaning, it becomes easier to understand the often ambivalent or apparently contradictory feelings that interviewees express about GIS. Though guided by scientific methodology in their work, interviewees realise that their data is provisional. Never-the-less, it is that perfect model which is aspired to. Thus Gary anticipates a model of salmon spawning, where prediction is factually precise:

"the GIS system that's been developed for the River Dee they'd try and work out what parts of the Dee are accessible by salmon and what they have said, where you have the gradient rising over a certain level that will no longer be accessible to salmon, and they have applied that to the digital terrain model, and come up with a little bit of red dots on the various tributaries and said salmon don't go above that point. **What they've now had to do is to sit down with the gillies from the river and say, "do salmon go above this computer generated point?"**", and they've been saying well "yes they do go above that" or "they don't go above that", so obviously that isn't the er.. the technology that's the problem there, it's our use of it".

Gary

Something of a self-styled sceptic to GIS, Gary appears delighted that the model of salmon spawning is so wrong, but significantly considers the solution is to provide a better model, rather than perceiving it as a problem with the GIS itself. This view reflects a general tendency amongst interviewees to regard problems incorporating data into GIS as a type of error, rather than as a conceptual issue. Thus error itself is often perceived as not being the fault of the GIS. Instead it is argued that data are inappropriately mounted on the GIS, or misinterpreted by the operator, while inconsistencies which arise from sets of 'provisional' data being overlaid are often perceived as glitches, which need to be tidied up. So Colin shrugs off the fact that his data set shows an upland bird in low land - supposedly impossible - and tidies up, that is removes these records, with a casual: "these things happen".

These diverse strands of understanding which contribute to the interviewees' view of the world create an extremely complex situation. On the one hand, interviewees are striving for the perfection embodied in the GIS - total vision and total manipulation. On the other hand, they recognise the implausibility of that. The imperfect field worker or body becomes simultaneously crucial and oppositional to

constructing the model of the 'real world'. By this I mean that, although the imperfect vision of the subjective field worker is a flaw in the scientific model, this imperfect vision is also essential to it, because it is the only vision that has the flexibility to shift positionality, to understand the complexity of things which are simultaneously true and untrue, such as impossible searches for the boundary between two habitats or the breeding sites of Marsh Fritillary Butterflies - in short to accept a world where reality is not singular.

The tension that interviewees identify between materiality and GIS images thus appears to be based on their experience of interacting with the world. It constitutes a productive tension, because it enables them to deal with a messy world which they recognise isn't entirely malleable to Foundationalist understandings. Concurrently incorporating other means of accessing the material world, it enables them to continue to exploit the utility of objective methodology, and the credibility associated with the scientific project, whilst simultaneously allowing other perspectives to inform their understanding. As James suggests, GIS is a useful methodology for constructing plausible stories about a world, which is largely beyond the grasp of the scientist:

"survey data ... one of the big fallacies [is] you produce an accurate estimate. It's always going ... to be way off it all gets a bit ridiculous when people invest huge amounts of effort in ... trying to be precise when the ... original data is very dodgy, and that's one thing that GIS helps in ... it takes you very little time to produce maps based on dodgy data, rather than spending a week trying to produce something by hand on ... crap basically [laughs] So it means that stuff that ... you would have previously discarded beforehand as not worthwhile doing, ... you would undertake that doesn't stop people constructing a story from it".

James

This conception of reality produces an understanding of the world through a series of realities - the GIS image, the experience of surveying available to the scientist in the field, and materiality itself. The interviewees accept that there are distinctions between these three facets. The material world is not wholly accessible through site visits or through the GIS, as there is no naively given world for the scientist to access. Rather all three aspects exist simultaneously, and operate as a source of tension between each other, for as Crang (1997) suggests in relation to the tourist photographs, they produce each other, both symbolically and in terms of material

effects. So the virtual road may eventually be built in the material world, and survey methodology might be as influenced by the structure of the GIS data set, as the mating patterns of Marsh Fritillary butterflies. Feminists have asserted the need to problematise the notion of the field: Katz (1994) suggesting that for social theorists, the field is everywhere. It seems however that what constitutes the field is a topic that has relevance to other disciplines. For these scientists, the field does not appear to merely exist out there, but also within the GIS image, and within what they acknowledge as their own interpretations. This insight possibly provides some explanation as to why binary gender structures do not map easily onto their complex understanding of the world, which seems to incorporate at least three perspectives. These multiple perspectives arguably function to disrupt binary gendered mappings.

Perhaps such argument also explains why GIS literature is very concerned with error and the interviewees in this study were not. Although they embrace scientific discourse, they recognise that the phenomena they are researching is sometimes beyond hope of such objective understanding. As Nigel suggests:

“Ecology is a very vague, fuzzy sort of science. It’s just because it is so vast. I mean ... there are more infinite parameters and you could only ever ... have data on a very few of those parameters, and so you’re predicting outcomes of ... b will happen, or b is the most likely to happen, or it could be c, or it could be d, but since **you’re always doing it with only very partial information, a very basic understanding of the system**”.

Nigel

Working with vast sets, where the possible links between them are beyond the scientist’s grasp, and the si(gh)ts of the system’s vision, these ecologists seem to recognise the fuzzy nature of data itself. They do not expect precision, or to construct a perfect model. So when Lucy expresses frustration that the GIS won’t do what she wants, the problem isn’t so much the little error, but the fact that the GIS can’t work with it, like she can:

“It’s nothing I noticed, the GIS pointed, pointed that out, but it’s just another hiccup, it will take another half hour to sort out, and all these half hours add up, I just haven’t got the time”.

Lucy

GIS, which held the promise of distilling pure geographic truths from a basis of precision and accuracy, seems to fail precisely because it is unable to shatter a

complex, elusive, tactile and mobile world into knowable objects with observable properties.

A central flaw in GIS thus becomes not its inability to model the 'real world' well, but its tendency to model it too perfectly, or at least to give the appearance of having done so. Ironically it is its faithfulness to the goals of the scientific paradigm that make it in some respects unacceptable to these scientists.

"when you do .. field survey and you're walking over bits of ground, you can only map what you can see, so some terrain is actually really, really complicated - so for one reason or other you may actually be ... walking along a ridge ... and be completely oblivious of ... some interesting feature or important feature, so these maps are ... again only generalised maps, **incorporating them into a GIS they seem to have this, this air of - rigour which perhaps is lacking from the original survey methodology**".

Colin

As such it prompts the fear that the data which it holds will either be accepted unproblematically as true, or that it will be taken to be a perfect representation which presents the whole story: creating apprehension that the technology's promise of perfect vision might produce an expectation of perfect solution:

"I mean **the more high tech equipment you have available, people will expect you to have an answer**. Oh, you've got data on a computer, you, what do you mean you don't know the answer".

Nigel

Interviewees therefore express fears that GIS might be seen as the perfect tool, which enables the scientist to work purely from their desk. Desiring perfect solution, obliged to provide scientifically viable answers, and partially captivated by the wonder of GIS, the relationship between interviewees and GIS is complex.

This fascination, together with the potential of a powerful and persuasive methodology, seems to be seductive, when the only price is that the user has to suspend their disbelief. Given that these interviewees maintain complex and ambivalent positions with regard to the relationship between the 'real world' and GIS, suspending disbelief is far from insincerity. For within this complex nexus of relationships, attitudes towards GIS become fluid and multiple. Requiring this 'truth', it seems users want to believe, and although the discourses they draw on have necessarily been presented in this account, as a sometimes coherent and progressive series of events, it would be naive to consider that the need to construct scientific

accounts centred on GIS does not feed and construct discourses concerning the nature of reality, and the appropriateness of GIS itself.

3.7 Conclusion

Recognising the provisional nature of data in the 'real world' and distrusting the Foundationalist premise where seeing is unproblematically conflated with description, let alone theoretical elaboration, interviewees partially distrust the GIS as a basis for making decisions, even though they simultaneously embrace it as scientific methodology. This constructs an ambivalent relationship between the interviewee, the 'real world' and the GIS, for where the GIS is considered to be a tool that merely manages data that they themselves collect, the rational basis for rejecting it is complex. It seems to provide the perfect medium for totalising vision, which distances itself from the blinkered sights of the fieldworker. However it is their very imperfection and subjectiveness that they bring to the field, in all its subtlety, that is valued by them, which they feel might be lost with the GIS. This seems to be the tension.

So GIS becomes pivotal in a shared illusion. Its value is based on its ability to persuade through the myth of perfect vision. Yet for these scientists, this perfection embodies its central flaw: it is simply too perfect. Recognising the provisional nature of data in the 'real world', they partially distrust the GIS, even as they enthusiastically adopt it. Their willingness to embrace it seems to be predicated on an ironic twist - perhaps it is an obvious one - but for all the emphasis placed on the value of the scientific method, ultimately, its value is derived from the far less tangible: the appearance of rigour, and the feelings of confidence inspired by it. These do however stem from faith in the Foundationalist project. It may be fantasy, but it is a potent one. It seems too that the limits of this discourse rise to challenge it, for it is their intimate ecological knowledge that challenges the very methods that they use to persuade others. Paradoxically it is GIS' faithfulness to the goals of the scientific paradigm that make it so persuasive, yet simultaneously partially unacceptable to these scientists.

Chapter Four

Locating the Embodied GIS User

4.1 Introduction

Technology does not only mediate relationships between the subject and the material realm, actively constructing the worlds we inhabit, it also participates in populating them. The body has been interpreted by feminists as a variable boundary that materialises only through social interaction, and thus it is constructed partially through the technologies that surround and constitute it (Correll 1995, Håpnes and Sørensen 1995, Haraway 1992, Morse 1994, Stone 1991b, Turkle 1995). The construction of both bodies and technologies must be understood as a symbiotic process, that is, where bodies and technologies lack both stability and rigid differentiation from each other, it is only their iterative performance that creates an illusion of both stability and separation. So while bodies construct technologies, technologies, as boundary objects, actively mediate the relationship between our own and other's bodies (Wolmark 1993, Butler 1990a, Grosz 1994). As discussed in section 1.4, the body is a *material semiotic generative node*, whose boundaries materialise through its performative citation in cultural practice (Haraway 1985, Marsden 1996). This does not deny the materiality of the flesh, but rather suggests that while the flesh is dense and capable of resisting discursive interpretation, the body is a surface onto which discursively constituted desires, fears and anxieties are projected, producing cultural values and norms from this process of inscription.

Acknowledging these processes, it has been suggested by some feminist theorists that technology could provide new ways of becoming embodied (Marsden 1996, Stone 1995b, Plant 1995). In this chapter, I explore the relationship between GIS technology and the embodied user by examining how interviewees locate their bodies in relation to the technology. For where the boundaries between the body,

technology and subjectivity are messy and ill-defined, this nexus of inter-relations which (re)produce each other, can be accessed by examining how interviewees locate their bodies and the technology. Drawing on post-structuralist accounts, which perceive the subject as fractured, plural and unstable, situated partially on the dissolving boundary between the body and the machine, the practice of technology thus provides an opportunity to explore the illusion of a coherent subject (Robins 1995). As discussed in section 1.4, the self emerges from this understanding as an ensemble of techniques and practices, which gain only fleeting solidity as bodies and subject positions are (re)produced in social practice, and thus the problematisation of these processes is essential (Probyn 1993).

In this chapter, the relationship between the body and GIS, and its implications for subjectivity, are explored in four sections. The first three sections examine the kinds of imagery that interviewees exploit to articulate their understanding of the relationship between their physical body and the technology. The focus here is not only on the material body, but on the kinds of bodily imagery that interviewees adopt to position themselves and others in relation to the technology. Initial and secondary coding of the interview data²⁴ revealed that where interviewees invoke the bodily, although the images they draw on are often complex, there was an overwhelming tendency for them to position the body either inside or outside of the machine. Although this binary structure does hold the danger of oversimplifying the intricate relationships between users and GIS, and the complex way in which this distinction is utilised by the interviewees, it does reflect a phenomenon which is empirically grounded in the data, and provides a structure for introducing their conceptions of the bodily. The first section focuses on images that separate the body from the machine, constructing a body which is either literally or metaphorically distanced from the GIS. Imagery that positions the body as an integral part of the technology is the subject of the second section, providing an opportunity to explore the implications of bodily incorporation. The third section problematises this dualism by exploring the tensions that arise when interviewees

mobilise the inside/outside dichotomy. The final section examines three possible subjectivities that emerge from the interaction between body and machine. It is argued that the abstract notion of expertise is related to bodies and the technology, with the effect of producing three differentiated subject positions: the magician, the apprentice and the inept. This section concludes by exploring how these subjectivities complexly relate to the way in which the body is positioned in relation to the machine.

4.2 Bodies without Machines

"The PCs that are on other people's desk ... are not very accessible, because you can't sit there, because somebody's already sitting there, and also they tend to have quite a lot of stuff around them, so it's not very accessible even if the person's not there".

Donna

The notion that the body is a materially separate entity from the technology it uses is a common theme throughout the interviews. It seems perhaps obvious that these scientists, who frequently construct the GIS as a tool, would envisage it as distinct from their own fleshy bodies. The image of the user's material body placed in front of the GIS, separate from it, is repeatedly invoked; however this tendency to position themselves outside the technology appears to be reserved for certain types of interaction, especially the problem of securing physical access to the hardware. One would expect the body to be present here, its inclusion being almost necessary as the operator attempts to get their eyes on the screen and their hands on the keyboard, while the notion that it remains separate is maintained by their inability to literally touch it. The suggestion is that there is a 'real' or material limitation on the opportunities available to secure intimacy with the machine. Difficulties in securing access may partly reflect the GIS strategy employed by SNH, which has channelled resources into training personnel, rather than purchasing hardware. Generally one GIS specification PC is provided per section or Area Office, which means that a single machine is shared between ten and fifteen trained staff. In practice however the emergence of a 'monopolising' key user, or special circumstances, such as the

²⁴ See section 2.5 for an account of primary and secondary coding analysis. This chapter largely relies on excerpts coded under the primary 'physical' and 'expertise' code.

GIS machine doubling as the PC for a particular project, aggravates the problem. Although the Project Board have attempted to emphasise to staff during the training course that a 'cultural' shift is necessary, so that the notion of a personal computer is replaced by viewing these specialised tools as a central resource, staff have often been reluctant to embrace this concept.

The argument that interviewees are separated from the technology by material factors is however difficult to sustain. Although access problems are often cited as contributing to lack of use, actual users are less likely to recount the 'hardware problem'. Discussions around issues of access, which were almost exclusively raised by staff trained in GIS who had not adopted the technology, often displace the GIS by concentrating on colleagues who are allegedly monopolising the hardware and who constitute an obstacle between the GIS and themselves. These obstacles occupy a central position, while the technology is relegated to the periphery, so that while the GIS is put forward as the desired object, the focus of bodily interaction is often between the interviewee's body and that of their colleague, as opposed to being with the technology itself:

"we also have another chap working in the office who is actually using GIS for his project, so ... if anybody gets to **shove Peter off his machine** to use the GIS, it's Joe, and so ... it restricts the amount of time that the rest of us can hope to access the GIS".

Joan

"there's a major problem in that we haven't got computers on our desk, so in our branch **we fight for use of a computer**".

Donna

"I can't say that it was my turn, **get off the machine**, I want to get on it".

Lucy

The aggressive imagery employed in these quotes is striking, especially as it constitutes the only violent images suggested at all by the interviewees. Although the degree of aggression varies here, and is sometimes expressed in terms of avoidance, for example, in terms of an unwillingness to dislodge a current user, this imagery is clearly bodily. It implies confrontation, not with the PC itself, but with another body: it is the colleague that becomes the focal point of interaction, even if, as in Donna's scenario, they are not actually present. The element of separation between the technology and the user appears to be predicated on their inability to even get close - another body stands between the interviewee and the GIS, while this

body appears to be constructed as a violent opponent, who actively inhibits their approach.

Interviewees invoke similar notions of separation from the GIS when their access is mediated by another member of staff. In the following extract, Colin is explaining his preference for sitting in front of the GIS with a more competent user than himself to assist him, but like Joan, he separates his own body from the GIS.

"I would have thought that **ftf**²⁵ is sort of essential. It's nice to be able to ... sit next to somebody, see how it's done, people who know what they're doing".

Colin

"I really haven't had enough opportunity to actually play around with [GIS], to find out what its limitations are. I know Joe who does do quite a lot of work on GIS - yeah, **I can look over his shoulder**, see what he's doing, and he explains it".

Joan

Similar processes to those occurring when users discuss issues of access seem to be operating in these descriptions. Thus although Colin and Joan both emphasise the importance of bodily contact, it is the competent user that becomes the focal point. However the body to body imagery invoked in these accounts contrasts with the descriptions of gaining access to the hardware. The aggression towards the other body, apparent when interviewees explain their access problems, dissolves, and the presence of the other body, although continuing to function to some degree as a corporeal intervention between the interviewee and the technology, also acts as a conduit through which the non-user might access the GIS; however this mediating influence does appear to continue to leave the body of the 'non-user' intact and separate.

Interviewees do not only situate their bodies outside the technology when another material body mediates or prevents their interaction. They also adopt this imagery, when, for a whole variety of reasons, they are describing not using the technology:

"I must admit I've **backed away** from using a computer myself".

Laura

"I wouldn't want to be **sitting in front of**, using GIS all the time".

Joe

²⁵ ftf is an abbreviation for face to face contact - a computer term for interacting with a person through direct contact, rather than on-line, through email etc.

"I haven't ... been able to have enough hands on experience to assess how much value it would be at the moment".

Joan

The interviewees' comments invoke imagery which is bodily, exploiting spatial metaphors to articulate the connections between themselves and the machine. The body is utilised to emphasise their separation from the technology. Unlike the access issues, and the users seeking assistance from colleagues, the body is not necessary to express these feelings. Laura could have articulated the same sentiments by suggesting she was reluctant to use a computer, while Joe could have merely said he didn't want to use GIS all the time. It appears that invoking the body as separate from the technology is central to their understanding of not using GIS. This seems to suggest that the aggressive imagery associated with access problems, and the tendency to position another body as a barrier between the interviewee and the technology reflects more complex processes than ones of simple material logistics.

The importance of the body being conceptualised as separate from the technology seems to some degree to result from the way in which interviewees understand GIS, and subsequently relate to it. There is a sense that these users are excluded, not only because their access is limited by practical concerns, but because, lacking understanding of the system, they are left outside. Tess implies this in the following quotation by suggesting that she hadn't used GIS since the training course partly because she lacked time to develop the skills, and partly because she felt the course hadn't been long enough to allow her to build up confidence:

"The time factor aside, I think if you feel confident about something, then you make time. **I've never sat down in front of the GIS machine here. Partly that is ... a confidence combined with time constraints [laughs]** if you felt entirely confident and you knew exactly why you were going to sit down there, rather than just press a few buttons, then ... you'd do it".

Tess

Tess' critical reflexivity here is unusual in the interview data. Despite her laugh, which betrays she is possibly uncomfortable with her admission, she does reveal that she lacks confidence. This contrasts with the explanations of most interviewees, who typically attributed their lack of use to practical constraints. She specifically invokes the bodily to articulate this concern by suggesting that she has never positioned herself in front of the machine.

The act of sitting in front of it seems to signify the possibility of meaningful interaction with the GIS; however it does not guarantee it, as the following quotes from users who are actually using the system suggest:

"you find that even getting into ArcInfo, **you could make yourself a cup of tea before you even get in there**".

Simon

"[GIS] just ... give useless statistics, so that's put me off the workstation, cos **it is impenetrable** you press a button and it goes off and does something and forgets that you're there waiting".

Colin

Both Simon and Colin invoke the interiority of the GIS, which is difficult for them to enter. They appear frustrated by the system's response, that leaves them externalised and isolated, completely separate from the processing of the system. Their bodies are left outside, inert and waiting, they are apparently excluded from the operation of the technology, which assumes the active role. Their bodily actions of inertia or of making a cup of tea signify their inability to access the technology, and the bodily is invoked here as a device to illuminate their exclusion from the GIS.

Positioning the body outside of the technology seems to suggest a complex structure of power between the user and the GIS. When interviewees adopt imagery which separates their bodies from the GIS, they have a tendency to construct themselves as passive in relation to the technology. Although being outside prompts the only instances of aggression in the interview data, this is clearly directed towards other bodies, rather than the technology. Separation from the technology is associated with an active GIS, that forgets the user is waiting. The GIS is busy processing: the user, excluded from useful work, is left (behind/outside) to make a cup of tea. Conversely, if the user is rendered passive by this process, the intactness of their flesh also seems to provide them with autonomy. They critically engage with the technology, suggesting that they haven't touched it enough to assess how useful it will be, or reject it on the basis that it is impenetrable or that they wouldn't want to be using it all the time. As Steve suggests, separation from the technology provides a degree of critical distance:

"**it's quite difficult to ... step back way after and think about what you're doing**, the approach you're taking and think in ... general terms about how you might make use of a technology".

Steve

Invoking the bodily, he asserts the importance of active separation, that renders the human subject powerful and decisive. The body is asserted as the centre of activity and agency, assessing the applicability of a technology. In this scenario it is the technology which is excluded from the focus of activity, even if as Steve acknowledges, this critical distance, articulated through corporeal separation, is difficult to achieve.

Such 'outside' imagery creates a degree of ambivalence. It is generally associated with users not accessing the technology for a variety of reasons, but the construction of an intact body seems to be predicated on flesh which can be passive and excluded, but alternatively separate, intact and potentially autonomous. This tension is reflected in the metaphors mobilised by interviewees. For although the machine is often attributed the dominant position as actively resistant to the bodies that attempt to enter it, the images of the bodies exploited to articulate this relationship are frequently active. It is a body that backs away and moves. Invoking the body as separate from the machine appears to reflect the complex relations between interviewees and the technology. Yet it is a mode of embodiment which has attracted little attention in the literature, which has largely focused on the incorporation of the flesh with technology (Haraway 1985, Stone 1995a). This is possibly because the cyborg has achieved greater currency as a vehicle of radical change, and the notion that separation might provide positions of control and insights into body/technology relations has been overlooked. Clearly however, imagery which places the body outside the GIS is complex, and is drawn upon not only to explain practical difficulties that form barriers between the material body and the material technology, but is invoked to articulate an emotional relationship between body and machine (Lupton 1995).

This complex relationship is problematised further by the descriptions of one interviewee - the only qualified GIS technician interviewed - whose accounts provide a notable exception to the descriptions of other interviewees. They differed in that he was the only user who tended to adopt this 'outside' position to describe direct contact with the GIS, emphasising the importance of people operating the system,

rather than the GIS itself. This is exemplified by his description of the issues which arise when using the technology for environmental decision making. This stems from his lack of ecological expertise, and his ecologist colleague's low level of competency in operating the GIS:

"there are communication problems, but not in our case, which is why ... I think the fact that we.. **sit on desks that are just across from each other means that whenever I don't understand something about the peatlands I can go across and ask Mary, and if she doesn't understand anything about the GIS she can come across and ask me**".

Duncan

"if I'm not here, or the GIS person isn't here, then there's an awful lot of work which won't get done, it just won't. **You need somebody sitting at the work station doing the stuff**".

Duncan

Duncan's descriptions emphasise the significance of trained GIS operators, which are essential to the functioning of GIS in SNH. The second comment, which invokes an image of an active user sitting in front of the machine, contrasts sharply with the inactive, inert user sitting in front of it, as presented in accounts of using GIS described earlier in this section. One could speculate that this anomaly reflected Duncan's level of competence, and his resulting feelings of confidence and control; however as other users developed skills, they tended to continue to use the outside imagery to describe not using the GIS. It is difficult to establish on the basis of one anomaly whether the technician's position is significant or not; however it does illustrate the complexities of the processes operating, and supports the contention that separation from the machine offers the potential of autonomy for the user.

If separating the body from the GIS may carry both notions of autonomy and exclusion, it becomes germane to question why this apparent contradiction exists. It seems to stem from the tension created by interviewees' need to embrace the technology, and their contradictory longing to reject it. Jaik implies this as he comments on the effect of the installation of the computing network on the organisation:

"when they put the network in .. they said ... not everyone will use it, but I think the vast majority of people actually do use the network, like 95% of us use it, and there's only ... **a few people that still refuse to use computers, and ... I mean it comes, you have to use it, other wise you're ... left on the outside, unless you've got somebody to go ... print off your e-mails or something, ... not a lot of us have**".

Jaik

The language chosen in this account reflects these tensions: to not use the network is uncomfortably exclusionary. The staff member is “left on the outside”, and depicted as refusing to work, rather than choosing or deciding not to work with the new technology. The term ‘refusal’ suggests that it is obvious to use the network, as if there is no rational basis for not participating, but the proviso that it is not necessary if one has someone else to interact with the computer on their behalf, suggests that with such ‘service’ it would be unnecessary to use the computer at all. Drawing on notions of progressive historical change²⁶, and in part captivated by the wonder of GIS, as discussed in section 3.4, interviewees feel compelled to embrace the technology, even if at some level, submitting to its demands are unpalatable. Sally exemplifies this contradiction, as she explains her reaction to working with a networked PC:

“I know I have changed because if I’ve got real important stuff in my in-tray, and that machine beeps and says you have a message, I won’t look at my in tray I’ll look at the machine, and ... **I really support anyone who says no, I’m not going ... under this pressure, and I’m gonnae ignore it, and fine, ... if that’s their way of coping, fair enough, but to me it’s not, that’s not coping, that’s ignoring it and hoping that it will go away**”.

Sally

Sally’s account acknowledges the material difference that the network makes. She is referring to the difference between feeling the need to respond to paper based work, where her colleague sends a task through the internal mail system, expecting a response in a matter of days, and her need to respond to an email, where the colleague is aware that she has received the request, and is able to respond to it almost instantaneously. It is understandable that Sally feels under increased pressure; however her account of this is rife with contradiction. She seems to be saying that she thinks someone who chooses to do the urgent paper based work, rather than responding to their computer isn’t coping, though this does seem a reasonable reaction. It is her response that seems confused, for she simultaneously admires their stand - their active agency - whilst rejecting it as a reflection on their inability to cope. She implies the appropriate course of action is to submit to the machine.

²⁶ This issue will be explored in chapter 5.

As Sally asserts that their hope is that "it will go away", she invokes an image of separation, which, to her, is ultimately unattractive. The power invested in these discourses echo Foucauldian understandings of power, where the strength of the machine is maintained by its hold over subjects who are free to choose. It does not demand submission of the flesh through force or violence, but the implicit assumption that it presents inevitable change, that should not be resisted (MacCannel and MacCannel 1993, Bordo 1993a). Force becomes unnecessary as users strive to conform to the dominant discourse, and the technology and the practices associated with it can be understood as a panopticon. The concept of a panopticon was adopted by Foucault (1977) to describe material devices which enable the threat of real or imagined surveillance to prompt individuals to conform to normalised modes of behaviour. The GIS, its users and potential users provide a means of surveillance that prompts individuals to conform to such working practices. Sally, aware that the colleague knows that she has received a request, feels compelled to respond to it rapidly, under the pressure of the real or imagined impatience/surveillance of the requesting colleague. To be inside the GIS therefore seems to reflect a level of conformity and acceptance of the dominant discourses mobilised through the practice of this technology. Alternatively, the outside position seems to embody an element of control and critical engagement, even as it constitutes exclusion. It is a position of some power, though ironically it is disapproved of, precisely because it initiates a separation between the body and the machine.

4.3 The Body Inside the Machine

"it was useful to go on the course to see what it was capable of even if ... straight away you can't go right into the machinery and do it yourself sort of style".
Laura

Imagery that imagines the body inside the GIS itself is a prevailing theme in the interview data. References to 'going into the GIS', 'sticking your head in', or 'dipping inside' are all common. The bodily is invoked consistently here as a means of describing interaction with the GIS, which as in the comments that place the body outside of it, is constructed as a space to be interacted with. Although interviewees

are not suggesting a material space that can be entered literally, it is clear that the bodily is a key image through which their spatialised understandings of GIS can be accessed. The notion of GIS as a space that can, or cannot, be entered becomes apparent in the following accounts, in which Richard and Tess describe the process of gaining competency with GIS:

“you've got to sit down and work your way through, work out how, **you've got to get into a package** haven't you?”.

Richard

“this problem I have with computers generally, and GIS in particular that y'know there's something out there, but **it's like a woolly wall** [laughs] You think it might be of use to you, or should be use to you, from what ... I've read about it, but actually, **knowing how to sort of get in and through the woolly wall and find out more is really just a big problem**”.

Tess

Richard's and Tess' comments both draw on the notion of an intact body, that existing separately from the machine, is faced with the task of entering the technology. The exploration of the GIS by the user's body appears to act as a metaphor for what is imagined as some kind of meaningful interaction with the system. It initiates a distinction between the excluded body, that waits passively for the machine to boot up, or lacks the competency to understand what is going on, and the body inside, a body which has the potential to work with the system productively.

The binary between inside and outside bodies does not however appear to create bodies that are identically oppositional. That is, the outside excluded body which cannot control the GIS, is not juxtaposed by an inside corporeal form, that is generally in control. Although the body outside is invoked almost exclusively to suggest not using the GIS, images that recall the body entering the system are not reserved for successful entry, but often, as in the examples above, to express the aspiration to enter, or frustration at futile attempts. Nor does such inside imagery suggest a body that is in control. The prevailing theme in these type of quotes is the submissive position of the user. It is the user who is “not capable” or who has to “get in and through the woolly wall”. Inversely the GIS occupies a more active, dominant position. The onus is on the user to adapt to the machine, which is sometimes imagined as actively resistant: the ‘woolly wall’ seems to be working against the user. There is however no sense of complaint or confrontation with the machine: it is

envisaged as the user's problem, while the notion that the user should enter the machine is accepted without question.

The deferential position of the user inside the GIS is assumed and emphasised, for example, by adopting metaphors which depict the user as clumsy and awkward: they are 'baby elephants blundering' inside, or deprived of vision, "in the dark"

"just in my section, I can think of five people in there who are all dead keen on using the GIS and sort of **blundering about, sort of baby elephants in it**, and not being very expert and making mistakes all over the place".

Pete

"I think that in IS²⁷ courses, no matter what it is, you learn the stuff so you think you know it, but once when you go back in, **you're in the dark** a bit again, and it's just a matter of playing with it for a while".

Bill

The GIS emerges from these quotes as dominant. The body that inhabits the machine renders the user ineffectual, for the distinctly corporeal forms produced through this interaction with the GIS seem incomplete and malformed: they are blind, they lack dexterity. They do not even possess control over themselves. These bodies serve to articulate and re(produce) the relationship between the powerful technology and the inadequate user, who is positioned as impotent, weak and incomplete. It is a docile body, that reflects the prevailing discourses which construct technology as inevitable and dominant, and the body functions to reflect cultural values, rather than as a site for self-determination (Deveaux 1994).

Entering the GIS therefore seems to be used not only as a metaphor to imply meaningful interaction, but also to (re)produce and reflect the assumption that the technology is the dominant element. The body produced from this union is weak, the (cyber)space that the technology generates is a hostile terrain, and to some degree, the suggestion is that the blundering body must adapt to it:

"the ArcView course, the two day one, I think it's been extremely beneficial for anybody that's been on it, the fact that it probably takes ... away **that stage of ... getting integrated with it**".

Terry

²⁷ Information Systems (IS)

The notion that it is the body that must be “integrated” with the technology is assumed, and interviewees frequently draw on images that suggest that it is the human body, as opposed to the technology, which must under go change. This is exemplified by the following comments about the two day training course:

“**obviously** you go on the course, and **you obviously get pumped full of information** for two or three days, or whatever it is, and ... as soon as you come back you've got ... to really go through it again, haven't you? **You've got to be prepared to stick in your head** and so forth”.

Richard

“I knew there was some things that I'd already forgotten, but ... moving so quickly from one thing to another, ... you don't get enough time to work on any one thing ... to get it **lodged in your brain**”.

Lucy

“on a two day training course, it's pretty intense, and by sort of half way through the afternoon on the second day, **your brain is totally fried**”.

Nigel

The physical alteration of the body is constructed as part of the process of interacting with the GIS, and of gaining competency. The user is “pumped full of information”, and the body is radically altered by this process. Yet although developing GIS skills is invasive and destructive: it fries the brain, submitting to this process is portrayed as obvious or inevitable. The user should be “be prepared to stick” their head in again, even if their brains have been fried.

These descriptions seem to reflect the tensions which arise from the notion that being integrated with the package is necessary, and discomfort with the unpleasantness of the process. As discussed in 3.5, the objectivity of science and technology, implicit in the rhetoric of GIS, creates desire through its promise of perfect vision and control (Rose 1992, 1993). However, while this pleasure must be disavowed to protect the integrity of pure objectivity, in these accounts the desire is problematised further as the interviewees intimate that gaining competency with GIS is far from pleasurable. The promise of dominance, provided by the possibility of totalising vision, is mitigated by the terror latent in the necessity of submitting to the machine. Richard repeats the word “obviously” and the phrase “you’ve got to” almost as a mantra, which naturalising and legitimating the act of submission, counterpoise the intrusive image of being “pumped full of information”. The images adopted in all of these quotations suggest violence to the head or brain. This exploits

a mind/body dualism, as discussed in section 1.2, suggesting it is only the mind that is effected by the GIS. These descriptions act to protect the fragile body on which the integrity of the subject is predicated implying that the technology affects only the hard, rational mind, leaving the body intact (Bordo 1986). Clearly however where the binary distinction between mind and body cannot be maintained, neither can the body be left unscathed. The act of gaining GIS skills constitutes a passive process of non-critical engagement with the technology, the implication being, the body is malleable, the machine is not.

The notion that the boundaries of the machine and the body are permeable, so that the flesh is altered through this process of interaction, while the GIS has the ability to incorporate fleshly material, supports the contention that vision and imaging technologies mediate the construction of a cyborg self (Robins and Levidow 1995). That is, while interviewees conceptualise their interaction with the technology as one in which they are incorporated into the GIS, this affects their conception of self and their own bodies, providing distinct bodies and subject positions. Although the literature has often focused on literal transformations of the material flesh, such as surgical procedures or material cybernetic forms, the production of bodies, such as those found in on-line virtual spaces, is also well established (Edwards 1995, Stone 1995c). It is a corporeal form which is produced through GIS. The brain may not succumb to the surgeon's knife in any literal sense, but the body does submit to the machine, producing a corporeality which is experienced as different by the user: the embodied user occupies a subjectively different position. Interviewees repeatedly invoke the body to articulate their understanding of the relationship between the body and the GIS, as it is practised, and that body is differentiated from one which does not interact with the GIS. It seems to give birth to a new embodied form.

As discussed in section 1.4, the possibility of new embodiments has been welcomed by some feminist and postmodernist theorists as an opportunity for radical change. Interpreting Haraway's cyborg as a position from which to resist, they argue that where the machine/human border is no longer self-evident, an understanding of

what it means to be human can no longer be assumed either (Haraway 1985, Ross 1991, Steffensen 1995, Plant 1995). As 'naturalised' unitary identities are destabilised, some Cyberfeminists have argued that the binaries of masculinity and femininity will be revealed as naturalised fictions. For in such ambivalent environments the notion that identity is ontologically given degenerates, undermining the narratives on which gender identity is predicated (Wolmark 1993). It has been argued that destabilising the boundary between body and machine is particularly beneficial to women, for while technology has often been interpreted as an extension of masculinist freedom and dominance, it is a division which has provided few opportunities for feminist resistance (Ross 1991). The challenge for Cyberfeminists has thus become to re-imagine and re-articulate the relationship, constructing a perverse alliance between machines and women.

The cyborg that emerges from inside the GIS, as it is practised in the organisational context of SNH, does not seem to provide a potential site of resistance. Although the body created from this union does not appear to be explicitly gendered, nor does it constitute an equal partner with technology, and the promise of forging some perverse alliance seems remote. It may implicitly challenge the notion of the male subject, as discussed in section 1.4, which is predicated on bounded and impenetrable flesh, but for this cyborg, technology does not so much merge with the body, but appropriates it. In fact, traditional binary gender categories seem to be reproduced. The hard technology could be interpreted as oppositional to the warm, soft flesh. The body seems to occupy a feminine position, where the imperfect feminised flesh must submit to the dominant masculine technology. The possibility of becoming a masculine body inside the GIS is lost, because the GIS user who submits to the machine is emasculated. The device adopted by interviewees of exploiting a mind/body dualism that could serve to masculinise the process of incorporation by suggesting that only the rational masculine mind is incorporated into the technology, does not function to maintain the user's control of the machine or of themselves. As discussed in section 1.3, Cyberfeminists have argued that as machines are increasingly attributed agency, they are coming alive at the same time

as women, so both could become disloyal to their previous masculinist owners. The possibility that the machine, as active other, might merely (re)produce a figure of masculinist domination, appears to have been over-shadowed by the tendency to celebrate its transgressive potential.

The body inside the GIS is appropriated flesh. It must submit, undergoing physical alteration, in order to complete the union. The agency open to the user, to resist or forget, is seen as undesirable, and even these become passive processes:

"it's almost ... like cramming for an exam, ... you've got two days where you have this data burst of information, and then for the week or two afterwards ... **it's all there, it's making your head spill, all the information, it's all there, and then slowly it trickles off**, and ... now, I'm sure there's things I've forgotten that I've done on the course".

Terry

Union with the machine is denied, as information trickles uncontrollably from the user's head. If this emerging GIS user is interpreted as cyborg, it is not a particularly inviting image (for me). Control is invested in the machine, and the human element relies on surrender. The malleable flesh is appropriated and the body submits to this process. Power is invested in the machine, and the user seems to submit to it, in order to occupy a stake in that potent position (MacCannel and MacCannel 1993). It is the user that under goes change, rather than the machine, and once integrated, as their transformed flesh melds with the machine; they must continue to submit, for blended with machine, there are new dangers. Joe implies this, as he describes his attempt to maintain his GIS skills through regular practice:

"I try to make sure I do use it a bit every week, although that's lapsed for a bit, but now that I've got access to it I will, **cos you get completely rusty** on it if you don't".

Joe

The metaphor for degeneration takes on a distinctly mechanistic tone, where the human flesh can now become rusty. It is no longer purely organic material, but a blend of flesh and metal.

That the practice of GIS is an embodied experience does however discredit one masculinist fantasy prevalent in relation to technology, and particularly in the Cyberpunk genre discussed in section 1.4. This fantasy is that technology allows the mind to transcend the meat, leaving the fragile human body behind. The rational mind, free from inhibiting flesh, constitutes a disembodied eye that lacks physical

limitation. The body produced by the practice of GIS discredits this Foundationalist dualism, which separates the pure reason of the mind from the distractions of the flesh, for even in this pure mind (cyber)space, the practice of technology remains an emotional and embodied experience (Grosz 1994, McRae 1995). The cyborg, as a body that evades pain, danger and death, is revealed as fantasy. This is not only because, as Morse (1994) cogently argues, the body inside the technology is intricately linked to the material flesh - whose eyes strain, whose back aches - but because the body created in the GIS is imagined by users as being subject to constraints that are similar to those experienced in the material world.

Although the literature has often emphasised the material aching body as the site of disruption (Lupton 1995), interviewees did not emphasise this at all. References to aching backs and sore eyes were barely mentioned in hours of interview, but their descriptions of interacting with the GIS are rife with bodily constraints, as Colin exemplifies, as he describes using the GIS to access data:

"you **stumble** across all the problems that that generates because ... there might be some problems associated with the data sets. The first time I tried to do that I had to get a special piece of code written, cos I couldn't do it using the software".

Colin

"having said that, I haven't been **stuck in** [the GIS] for three hours, in which case I would say it wasn't fun".

Melanie

The body in the GIS "stumbles" and gets "stuck", and although this is clearly not meant literally, it betrays that it is the body itself which is the excess of this particular cyborg fantasy. The body in the machine continues to be subject to corporeal limitation, and is as likely to be trapped, constrained or damaged, as its counterpart in the material realm. For the body in the GIS, like the material body, is produced through performance, and if it is beyond harm in any literal sense, these different bodies share the same process of constitution, and the same possibilities of limitation and danger. In the virtual space it is not significant that the body has no material form, since where all symbols appear as objects, it occupies the same status as any other object. That is, because the virtual body masks the apparatus of mediation, the referential collapses into the symbolic field (Morse 1994). This constructed flesh thus has the effect of mitigating the experience of the technology, potentially

mediating how that interaction is understood. The body constructed inside the GIS is not a site of boundless possibility, but within the context of the experience of the technology, it does have limitations. For Melanie, the possibility of being imprisoned in the GIS becomes real.

The body inside the GIS experiences, and those experiences both construct and reflect its relationship with the technology. Although it is not a material body - and it is important to continue to acknowledge the difference between various types of representation²⁸ - it has material effects. How the body is practised in its interactions with the GIS reflects the power relations between the technology and interviewees. This process is implicit in the following accounts, in which Terry comments on the uptake of GIS in the organisation, and Steve reflects on the difficulties of applying GIS to his current statistical analytical duties:

"I think a lot of people still **try to grasp everything** it can do I've not seen too many early user questions, y'know, people trying to **get a footing**".

Terry

"the GIS side is yeah, an area of concern that, that is - it's something that's really difficult to **get a handle** on maybe".

Steve

This imagery draws very strongly on notions of gaining control through corporeal stability. The sense in which users attempt to come to terms with GIS is expressed in a way which focuses on the bodily, so that achieving control of the flesh is equated with accomplishing technical competency. The stable footing that users are trying to achieve activates the body as a centre of potential agency, one that stands independently.

Yet if the body inside the machine provides a potential source of agency for the user, which offers the hope of bodily autonomy through being able to "grasp" the GIS, interviewees' descriptions of using the GIS, suggest that this possibility is not realised:

"I think I'm getting **bogged** down in finicky little things that we didn't cover".

Lucy

²⁸ The politics of different representations are different: being raped on line is not the same experience as sexual assault, and having your brains fried by a GIS course is not the same as physical violence. To fail to recognise this, merely perpetuates the modernist myths surrounding the malleability of bodies (Van der Ploeg and Van Wingerden 1995).

"I think sometimes you've just got to go with the flow maybe, but **new technology can swamp you**, and it can be frightening, and I can understand people's fears".

Sally

"I think that **we've been flooded with technology**".

Sally

"I'm not afraid of technology, I like to keep up with it, I think, I think it's good to - to recognise technology as a tool, and not something to be dominated by, and I think it's necessary to keep up with it, in order to take it forward, and not get **swamped by it**".

Terry

The text is rife with images of the body being swept away or swamped. This invokes a picture of an out of control body, conquered by the machine, as it draws on the very disturbing notion of not being able to stand on one's own feet, and all that this signifies. These comments seem to reflect interviewees' ambivalent attitudes toward the technology, for even as they express their enthusiasm and acceptance of GIS, they articulate their fears and disquiet with it. Disavowal is prominent here, and Terry's fear surfaces in his denial that the technology frightens him, while Sally attempts to displace that fear, locating it firmly in other bodies. The fear of losing control of their body acts as a metaphor for their own discomfort with GIS.

An interesting aspect of these descriptions is the tendency for interviewees to draw on water based imagery: they "dip" or "dive" into GIS, are "swamped" by it, or "bogged" down and "flooded". This is particularly significant since the tendency to refer to water when situating the body inside the technology is the only instance in all the interview data where a specific image is consistently used by different interviewees. This suggests that the adoption of this metaphor is significant, and is a product of a pervasive discourse, which shapes users' experience of the technology. Morse (1994) suggests that the desire to enter the machine, and be consumed by it, is predicated on the fantasies of both escaping the fragile body, as discussed above, and of returning to the womb. It is tempting to interpret the water based imagery as a product of this longing: the body craves the comfort of the amniotic fluid. However, although interviewees do construct the GIS as watery, they clearly approach it with trepidation:

"I see it as an excellent opportunity ... to ... **get your foot in the door**, start that little bit, see how it feels, and then just before **you go up for the high board and dive in it**".

Terry

The mixing of metaphors seems to reflect Terry's ambivalent relationship to the technology. The GIS is certainly not imagined as a comforting space to withdraw into, and even though Terry retreats from viewing the watery GIS as actively hostile and dangerous, it continues to demand extreme caution. This does not necessarily undermine the notion that the desire for GIS reflect a desire to return to the womb. Irigaray (1985) argues that this desire is counterpoised with terror at being consumed by the mother, creating the deeply ambivalent relationship which is apparent between interviewees and the GIS.

Fluids have however also been aligned with the feminine. Irigaray argues that fluids resist adequate symbolisation, and have been rejected by masculinist thought, which strives to view nature in an ideal state, that keeps theory tidy. Fluids are volatile and unstable: they resist adequate interpretation (Irigaray 1985). The tendency of interviewees to situate their experience of GIS within such fluid imagery presumably reflects their experience of the technology. As discussed above, the body inside the GIS appears to be emasculated, lacking control, it is acquiescent and passive. As a feminine body it is subject to penetration, and its boundaries, unlike that of the fantasy of the male subject, are permeable and susceptible to physical alteration. As discussed in section 3.5, it is a hazardous to interpret categories which have traditionally been aligned with specific genders as necessarily representing male and female. To juxtapose hard technology against soft flesh, and interpret this as a gendered distinction, when there is no other evidence to suggest that they are experienced as gendered, harbours the danger of merely reproducing the very categories that feminist theory has attempted to destabilise. However, the tendency of interviewees to appeal to such fluid imagery, particularly in the context of the power relation they suggest between themselves and the technology, empirically grounds the claim that the body in the GIS is feminised. It appears that the cyborg body constructed through the practice of GIS, rather than presenting the possibility of radical change, merely reproduces a site of domination.

If the body inside the GIS is physically altered by this process of interaction, it become pertinent to question what becomes of it when the subject withdraws from

the GIS. The cyborg body cannot really exist outside of the technology, that is, it cannot leave, because it is a product of the union. The body of the operator may co-exist with the cyborg persona, but the body inside the GIS is enacted through the interaction. Analysis of the interview material suggests however that when the GIS leaves the union - suddenly and without warning - the body of the user continues to experience, as the following comments suggest:

"a couple of months ago, all the computers were down for one and a half days, everyone was **totally lost**".

Joan

"As soon as the network goes down there's no available computing use, **you feel as if it's almost as though you've come up against a brick wall** - at least I do".

Danny

"when the network goes down, **people - hands up - oh no, the network's gone down - my tools are taken away from me, I could do nothing, I feel inadequate**".

Terry

Rather than regaining feelings of control, users seem traumatised by the separation. The union with the machine, however frightening a prospect, becomes more attractive than being abandoned by it. There is a sense that the body created through the practice of GIS is immobilised by its loss, an emotional response that seems to highlight the ambivalent relationship that users have to GIS. The machine constructs a body which is feminised, passive and ultimately dependent, and the user, as in Irigaray's (1985) account, is torn between the desire to embrace the technology, and the urge to escape it.

4.4 Turning the Body Inside Out

GIS has the effect of constructing bodies, which mediate the interactions between the technology and its users. They represent and constitute complex relations; these bodies reflect anxieties, hopes and fears, even as they (re)produce them. The outside body and inside body are utilised to articulate different relationships; however the organisational structure adopted in this chapter of examining each type in turn does not imply that there are two discernible groups of interviewees: one submitting to the machine, the other disengaged and excluded. In fact it was common for the same interviewee to adopt both positions. This can be illustrated by examining the incidence of two secondary codes, 'inside' and 'outside',

appearing in the same interview. Although this is not intended to provide 'objective' evidence of such a relationship - the original coding of the material to produce the physical result file, and the subsequent secondary coding is doubtless a qualitative process, prone to simple errors and value judgement - it does however provide a quantitative indication. From the first round of interviews, the transcripts of fifteen interviewees contained at least one 'inside' code, while those of eighteen had at least one 'outside' code. Of these two groups, thirteen interviewees were in both. This strong coincidence supports the contention explored in section 1.5 that users can be multiply positioned, so that in the space of a brief interview they can simultaneously adopt seemingly contradictory relationships to the technology.

This phenomenon can be exemplified by examining how one interviewee, Donna, who was selected at random, mobilises the 'inside' and 'outside' positions to articulate her complex relationship between computing technologies and herself. Donna is the European Liaisons Officer and has broad ranging responsibilities for monitoring funding opportunities, changes in legislation and other EC related information. The first interview with her was conducted prior to her undertaking training, and at this point, she was utilising a range of computing applications, including wordprocessing, spreadsheet and internet packages. Her first reference to computers, which utilises a corporeal image, arises as she describes the frustrations of using the internet. Her complaint that it was "slow" proved on clarification to reflect the difficulties in locating appropriate sites, rather than the time taken to download pages:

"I find it quite frustratingly slow **getting from one place to another**, especially when ... you're not absolutely sure that what you want is going to be there".

Donna

That understandings of cyberspace are dominated by spatial imagery is well documented in the literature, which asserts that cyberspace, rather than being a space which negates geometry, is actively constructed through this strategy of mobilising spatial metaphors (Graham 1998). Donna adopts the spatial metaphor to explain her use of the internet, and invokes a corporeal form, which travels from one place to another, as integral to that understanding. The body that undertakes this journey is clearly inside the technology.

As the interview progresses, and Donna comments on the difficulties in securing access to hardware, she invokes the body again:

"GIS is only on one of [the PCs] in the branch at the moment, so there is going to be quite a problem when it comes to ... wanting to use a GIS facility. I mean I think that the move to making people do more, or wanting people to do more on the network is another issue as well, whether ... people really need to spend all of their time on a computer or not. I don't think people need to spend all of their time on a computer, but it's becoming more and more that - **it's necessary to be linked up to the computer** all day so that you can see a message flashing up to you, and so you can access information which is on it, and ... **I haven't got a PC on my desk, so I can't do that**".

Donna

Donna's comments reveal a tension between her argument that it is difficult to secure access to the machine because of the lack of hardware and her assertion that such access is unnecessary anyway. The body is invoked as separate from the GIS, and acting independently of it. This separation is in part enforced, because there isn't a PC on each individual's desk, while it partly arises from the active choices of embodied people, who don't need the technology to perform their jobs. The construction of this separate, independent body, that operates outside the technology, is qualified by her admission that it is increasingly necessary to be "linked to", if not inside, the machine. The corporeal form is thus utilised by Donna to express her ambivalence towards the technology.

Donna maintained the tension by situating the body both inside and outside the GIS in her second interview, which took place after she was trained. Discussing the difficulties in obtaining data, she invokes a corporeal form interacting with the machine, and distinctly inside of it:

"I think not having the data is another big problem, cos the GIS provides the ... background for you to put your data onto, so that you can analyse it against other geographical parameters, and **if you haven't got sufficient data when you're inside, if it's not in a good enough format, then you're stuck anyway**".

Donna

Although it is unclear whether Donna is "stuck" inside the machine or outside of it; immobilised or banished, the GIS is clearly conceptualised as a space which the body can enter, even if entering it can prove problematic. This series of quotations illustrate that the 'inside and 'outside positions are adopted by the same embodied individual to articulate the complex relationship they hold with the technology,

indicating that it is a relationship which is fluid, unstable and characterised by multiplicity.

The fluidity of this relationship between machine and body is particularly marked when interviewees exploit both the inside and outside positions within the same sentence. Judy does this as she explains how her use of the GIS has been mediated by the assistance of a more experienced user:

"I have **tapped into the system, but via Simon**, ... whose been using it quite a lot for his work, so he was very familiar with it, so when ever I've needed anything, or thought well, maybe that's in the GIS, I've gone to him and said, look, **can you tell me what of this is in there, and if so can you help me print out maps**, so I have used it once or twice, but actually really just through somebody else who can do it much more quickly than me".

Judy

In Judy's description, the interiority of the GIS is striking: Simon goes "in" the GIS, tells her what "is in there" and helps her "print out". So even if it is a space from which she appears to be excluded by her lack of GIS skills, her ability to interact with the system through Simon promotes an understanding of the technology as both inside and out. Similarly Sally, commenting on the utility of GIS for assessing planning proposals, draws on inside imagery:

"I can see that in future I'd be involved in GIS, probably special planning If we want a major road **you could go into, you could go into the GIS**, from what I've seen of it, which isn't very much and put on the map where the road's going be but ... whether I'll be doing that, I don't know".

Sally

The prospect of entering the GIS is only mitigated by her suggestion that this will be in the future, and may not be something which she is involved in. This temporal displacement has the effect of situating her present body outside the GIS, while maintaining the possibility of being inside in the future. The relationship between the body, suggested by the quotations in this section, is fluid and dynamic, reflecting the complexity of GIS as it performed and understood.

4.5 Creating Subjects

The practice of GIS constructs bodies, and thus there cannot be an oppositional relationship between bodies and machines; neither pre-exist as discrete entities, rather they emerge through their interaction with each other, creating a

blurred boundary between the embodied self and the GIS.²⁹ The subjectivity of the user is thus not predicated on the essence of a material form, but stems from the practices which construct the user. Recognising that the stability of material flesh is inadequate as a basis of the self, the subject becomes provisional, predicated on contingent social practices, which form an embodied subject who is multiple, fluid and contradictory (Fuss 1990). The individual is rendered discursive, rather than unitary, and exists as a product of the discourses which it both contributes to, and is formed from (Ormrod 1995). The illusion of a coherent and unitary identity thus becomes a function of discourse. For if subjectivity is predicated on the body, as it is performed and constructed through language, as GIS manufactures embodied users, it inevitably produces subjects. Technology thus contributes to subjectivity, as in this symbiotic relationship, technology is an active constituent of the subject (Lupton 1995, Stone 1995b).

In this section, I intend to explore how the inscription of bodies through the situated practice of GIS produces subject positions by examining notions of expertise. Degrees of competency emerged as an important factor to the interviewees in this study, and it is clear that as users developed (or did not develop) GIS skills, the concept of expertise functioned both to structure their relationship to the technology, to themselves and to other embodied users. This discussion is not intended to suggest that the subjectivities described in it are the only discernible ones that emerge from the practice of GIS at SNH, but are explored here to usefully exemplify the processes that are occurring. Although the subjectivities that emerged from these interactions are necessarily complex, three figures appeared to recur throughout the interviews: that of the expert, the developing novice, and in opposition to these, the incompetent.

The figure of the expert was most actively constructed by those who identified themselves as lacking in competency. As discussed in section 4.2, it was

²⁹ Inversely this interaction also produces embodied machines, which will be explored in the following chapter.

common for interviewees to exploit the skills of a more advanced user to mediate their interaction with GIS:

"I would probably **turn to someone like Simon** he's far more au fait with using computers yes, **tend to turn to him** for anything I wanted put into a ... project, or anything, or inputted into the system".

Laura

"I think maybe, not necessarily now, but maybe in the not too distance future, a person based say here at Bonnington for a period of time, so people know that should they want to do something through ArcView, there's **somebody there whose approachable**, who is there to assist them, and on hand".

Terry

These comments seem to construct a sense of distance between the interviewee and the technology. The physical presence of both the interviewee and the expert user is apparent; both are embodied as interviewees emphasise the physical proximity between them, as they actively 'turn to them' and 'approach them'. Inversely, the technology is distanced, as interviewees express their desire to interact bodily with their colleague, as opposed to the GIS. This has the effect of juxtaposing the expert body with the technology, for where the former is touchable and approachable, the implication is that the latter is not.

The notion that the expert is more approachable than the GIS is exemplified in the following quotes, where interviewees describe their understanding of how the expert has interacted with the technology on their behalf:

"you sometimes lose some of the stuff you've been working on if you ... haven't saved it to the moment it's crashed, but sometimes **you can never find what's happened to it. We have a couple of chaps in the office ... who are very, very good on the computers and they can usually be prevailed upon to know what's hap..., what's doing**".

Joan

"he said that he'd produce the maps. **I honestly don't know how difficult it was for him to do it**, I don't know if he does a lot of it, so he's more au fait with it - at the back of my mind I kept thinking ... you could analyse it more readily using GIS and certainly relate what ... was going on. No ... I must admit I didn't, he just went ahead and did it".

Laura

These descriptions are marked by a lack of understanding. The process of what the expert has done with the GIS is rendered mysterious, and often the interviewee doesn't comprehend the skills or functionality that have been employed to achieve a needed output. In some cases the uncertainty surrounding the GIS and those who 'understand' it, seems to be translated into the almost mystical, as Rose illustrates in her description of the possibilities for exchanging data with other agencies:

"Maybe it's an impossible dream, but these are GIS persons that ... are telling Roy that this was possible ... different languages or something conversions or something".

Rose

Lacking understanding, for Rose, the GIS loses substance, but exists instead like a "dream" beyond the bounds of touch or of a more corporeal, tangible reality. Drawing on the notion of "different languages", which are incomprehensible to her, and repeating the word "something" as a substitute for informed understanding, she juxtaposes their competency with her lack, discursively constructing notions of expertise. It is the subjectivity contained in this expert body that lends the dream substance, and thus the embodied expert functions to both create a material point of interaction, and to solidify the concept of expertise within the flesh.

The relationship between the expert and interviewee varies, depending partly on the type of interaction occurring, for example, whether the user is seeking support or relying on experts to perform services. Generally however there appears to be a degree of admiration, even reverence, for the person who is attributed expert status. The position of the expert is constructed as one of dominance in relation to the inexpert user, so Joan suggests that she "prevailed upon" them, while Pete doesn't want to "impinge ... on people's time" and is concerned that they might leave him:

"I mean from my personal point of view, I don't think I have the expertise to be able to do everything that I need to do to import the data into ArcView, and to be able to manipulate it to the degree that it needs ... to be manipulated. I am sort of, will be y'know concerned if all that sort of GIS experts went, went west".

Pete

As he hesitates to articulate his concern, Pete seems to invoke a fear of abandonment. The body of the expert, itself a conceptually laden and evocative label, is positioned as central to his sense of ease with the technology. The spatial metaphor of going west - used in this quotation in the context of disappearing, rather than in terms of a specific geographical place - appears to reflect a need for physical proximity, the hope of touching the expert, of having them sit beside you as you interact with the GIS, of ftf contact. It is a need which is constantly re-iterated by the interviewees. The reverence expressed by these interviewees stems from their need for the bodily presence of the expert. Physical closeness provides security, even if that relationship is complex, because it is mitigated by the concern of impinging on the important expert. The expertise inscribed in the body makes it both sought after and revered. It

is both obtainable, providing a means through which the untouchable technology might be accessed, and potentially unobtainable, since the agency of the expert to refuse to help, or to physically leave, is latent.

As discussed in section 2.3, although the GIS strategy pursued by SNH was intended to provide the two hundred staff who undertook the GIS training with basic skills, it rapidly became apparent that only a handful of trainees were developing any proficiency with the system. The expression adopted to refer to this group, initially by SNH staff, and subsequently by myself, was GIS super users. This label seems to exemplify the status afforded to those users who developed expertise, and to differentiate these experts as a distinct group. Expertise thereby became a property of certain bodies, and while expertise itself was latent and manifest, these bodies signified it. That is, it does not appear externally to the bodies in which it is inscribed (Foucault 1977).

Embodying expertise through their ability to control the machine, these bodies developed as a focal point of wonder. This is aptly illustrated by an incident in the second interview I conducted with Laura. We were sitting, chatting comfortably in the Clydebank office library. Earlier in the interview, we had discussed the super users. Most of their names were now familiar to me, since they were mentioned continually by interviewees as the person who had helped them, or provided services. The conversation had moved on, and we were discussing hardware provision, when a super user happen to walk past the partition windows. Laura broke off, and commented "that's George Brown". Our conversation halted, and we both sat mute while we followed his progress down the corridor. When he returned a few minutes later, we repeated the whole process again. His body seemed to provide a source of mutual fascination that is difficult to explain. It appears that the expertise embodied by him differentiates his body from others: he becomes a spectacle.

That bodies are inscribed with expertise and differentiated from those who lack it seems apparent. However, an interesting aspect of this inscription is that users

do not inscribe their own bodies with expert status. Joe, selected for interview because he was identified as a super user, exemplifies this, as he describes his colleague's proficiency at wordprocessing:

"I wouldn't call myself a real expert in computers, cos as I say it's only really been the last two or three years [that I've used them] ... people like Malcolm he's been fairly familiar with computers right from school, so there's a lot of ... the more intricate things, he knows how to do, that nobody else here really knows how to do, like changing the way things are ... set up and changing your tool bars at the top and .. the less obvious, things that aren't to do with your general ... wordprocessing, anything a little bit more complicated, and I mean ... I'm learning some of those ... tricks, but I'm not that sort of an expert".

Joe

Joe initiates the same distinction between experts and those who are not 'au fait' with computers, but rejects his own body as a site of expertise. This analysis is far from inevitable. His justification for suggesting that Malcolm is a proper expert is that he is a proficient wordprocessing operator, a software which was generally constructed as holding less status than GIS in the interviews. Nor should the functionality which Joe identifies, such as changing the tool bar, necessarily be considered as particularly complex. They are an integral part of most wordprocessing software, and require no special skills to learn. Malcolm appears to be constructed as an expert for Joe, purely on the basis that he can perform operations which are beyond Joe's understanding. His expertise is predicated on the inexplicability of his skills.

Expertise therefore appears to be predicated on its ability to produce wonder and mystique. The inexpert user reveres the expert, because they are unable to understand the process by which they have interacted with the machine. The wonder associated with the technology, invests authority in the body of the expert, as the degree of fascination associated with the GIS is extended to its operator. To expand the metaphor of magic employed here, it seems that such bodies can be usefully thought of as magicians. As discussed in section 3.4, the technology is both magical and mystical, and it is the ability of the magician to operate it, to appear to control it, that imbues them with magical status. For the embodied user however, by definition their own actions are not shrouded by mystique. This does imply complete self-knowledge on the part of the user, but suggests that familiarity breeds contempt, that

is, their own skills cease to amaze them, even if they continue to be in awe of the technology and its potential to produce sophisticated outputs.

These tensions are aptly exemplified by Terry's understanding of technologies. Terry had little formal IS training, but was exceedingly positive about the benefits of GIS, and enjoyed using computers. After the ArcView course, he not only gained considerable skills in this package, but, under the instruction of a trained GIS technician, began to learn ArcInfo - the more complex command driven GIS on which ArcView is based. In the context of an implementation where most trainees were not even using ArcView, this was astounding both to his colleagues and myself. However Terry was keen to relate that such abilities had advantages and disadvantages by using Microsoft Office, rather than GIS, as an example:

"certain Microsoft Office applications like Powerpoint, they do presentations, and EXCEL for spreadsheets, I found I've come to know them like the back of my hand, and you can produce some really incredible stuff from what seems like a basic package, and as I say that's good because you can actually do that, but it's bad, because when other people know you can do that: 'Oh look at that! Oh we want something like that as well' [laughter] but the better you produce, the more people want you to do them, so you just kind of increase your work to yourself, so really I should be doing really shoddy crap outputs, and make life easy".

Terry

To explain the difficulties associated with gaining expert status Terry introduced Microsoft Office into the conversation. His enthusiasm for GIS was predicated on a continuing element of wonder, and it seems plausible to suggest that he exploited this package, which was now as familiar to him as "the back of his hand" in order to be able to describe it as a "basic package" - a description which would have been more difficult to apply to the GIS that he was still in awe of. Introducing Microsoft Office to exemplify his account, thus enabled him to maintain the tensions between the "basic package", the "incredible" outputs and the impressed colleagues, who were making demands on his time. In doing so, Terry suggests that although he both acknowledges the impressive nature of the outputs generated and understands the reactions of his colleagues, he continues to construct himself as someone using a familiar and basic tool, rather than as an expert.

The competent are not a source of wonder to themselves. Although they exploit the distinction between magicians and others, it becomes difficult to interpret

themselves as such. So while, like Joe, they may admire the Magi, and aspire to learn “some of those sorts of tricks”, they can only ever self identify as apprentice magicians. The magic of the machine rubs off on the magician, who is constructed from this process of othering. The beginners “feel just ever so slightly empowered, but they can't.... [laughs]” (Colin). It seems difficult for interviewees to articulate exactly what can't be done, precisely because it is its inexplicability that creates the sense of power. It seems no one can hope to be a magician.

There is an alternative viewpoint to this though, that suggests that there are other arenas of expertise. Alan suggests this, as he responds to my question about who prepared a contract for a GIS company by suggesting that the important skills utilised were ecological, rather than technical:

“SL: *is that something that's been done by the Local GIS Facility?*

yeah ... they did the contract and all that, but **she doesn't know the first thing about it**, so I basically did all the checking of the sites, stuff like that”.

Alan

“without being disparaging about Duncan [the GIS technician], he's only been with us a short period of time, and **he doesn't fully understand what we're about, and his main job is er strictly as a technician, and it's up to us to define what we want him to do**”.

Colin

These comments acknowledge the contribution of areas of knowledge outwith GIS, and although these interviewees are, or can be, equally reverent of the expertise associated with GIS skills, they emphasise the importance of ecological skills. The interesting point perhaps is not that the Colin and Alan are aware of their own skills base and value it - after all, these staff are professionals, and are engaged in work where ecological knowledge is primary, but that others, at least in relation to operating the GIS, don't. The importance of ecological knowledge is obscured by the magic of the technology.

If the practice of GIS produces apprentice magicians, it also holds the possibility of creating the inept as an oppositional subjectivity to the revered magician. For if interviewees construct others as magicians, and sometimes self identify as apprentice magicians, a subjectivity which relates to not using the technology may also emerge. One strategy employed is to assess the utility of GIS, and to reject it on a ‘rationally’ argued basis:

"it's ... slightly ... specialist ... - I think to be able to use [GIS] efficiently, you'd have to use it more regularly than we'll have the opportunity to do".

Laura

"There's other people who will give it a go, but the feeling is that it's, **it's quite a difficult thing to get to terms with**, and the only way you're going to do it is if you've been on the training courses, and to start using it ... quite regularly, and if you don't do that, then you'll soon forget how to use the system, and ... if there's nothing on it that you could use anyway, then ... you're probably gonna forget how to use it".

Jaik

These types of comments suggest a coherent argument against using the technology on the basis that GIS is perceived as a complicated software, which for staff working in a pressurised environment, is too intricate to learn, as the acquisition of skills cannot be justified on a time effective basis. This arises because the skills are highly specialised, and staff do not feel that the effort entailed in learning the system would be repaid by their anticipated use of it, particularly as they feel that the limited tasks which they need to do can be performed more effectively, and efficiently, by a 'proper' expert, or by themselves using more traditional methods. Therefore the 'efficiency, time saving' rhetoric associated with GIS is not supported by their experience of it.

This logical argument is however to some degree undermined by the potency of the magician subjectivity, where the inept emerges as a necessary other. For while interviewees suggest that some bodies are inherently magicians, others are rendered inept:

"Malcolm I don't think he's done the GIS course, although he's a bit of a computer whiz kid, so **I'm sure he, he would pick it up pretty quickly if he wanted it**".

Joe

"my brother's very interested in computers. **I'm sure he'd love to have a go on a GIS thing**, and it's just that ... different people are interested in different things, and some people love what they can do on a computer, they love the way it - does things for them, don't you think?".

Kate

As Malcolm and Kate's brother emerge as magicians from these comments, Joe and Kate contest the notion that expertise can be achieved through choice or practice. Thus while Jaik suggests above that you need to do the course, and use the system regularly to become competent, Joe is equally confident in his declaration that Malcolm could easily use the system if he wanted to, despite the fact that he has never been formally taught. Meanwhile, Kate constructs herself as inept. By

suggesting her brother would “love to have a go on a GIS *thing*”, as opposed to saying he would ‘love to have a go on a GIS’, she seems to be producing herself as technically incompetent. By adding a clearly inappropriate word, which is actually completely unnecessary to her sentence, her unease with the technology juxtaposes and augments her brother’s competence. She is excluded from the emotional and intense connection that her brother has with technology. The body of the magician, whose relationship to the GIS is constructed as inherently different, creates the inept, who lack access to this intimate interaction with the machine.

The construction of magicians therefore appears to produce the inept, even if embodied individuals do not self-identify as belonging to this subjectivity. For in effect there seems to be a certain disjuncture between the rationally argued reasons that users expound to explain their lack of expertise, and the emotive language used to provisionally distinguish the expert from the inept. It seems that although users who do not develop skills construct logical reasons to support their position, the mechanisms by which they relate and develop that position are more emotive, and less logically argued. Certain people are just magicians, such as:

“this guy whose got a thing about computers, and **he always can pick things up so quickly**, and then ... he's there, and it's ... really good”

Sally

While others, like Rose, are inept:

“do you really want to do it yourself, when **you'll never be as good as that person**, ... they're bound to be able to do it in a better way than you are”

Rose

The inept body is also apparent as interviewees describe their interaction with the GIS. As discussed in section 4.3, it emerges from the practice of GIS as stumbling and lost, and the corporeal is used as a device to articulate lack of control and lack of expertise. The body, as it interacts with the technology, is therefore central to the production of subjectivities. The revered corporeal magician emerges as a potent subjectivity, to counterpoise the embodied instability and insecurity that is solidified in flesh, in the form of the inept.

The practice of GIS in this context produces three subjectivities associated with discourses of expertise: the magician, the apprentice and the inept; however

none of these correspond consistently or exhibit stability in relation to particular embodied individuals. These subjectivities are fantasies, which are self-knowingly embodied by no-one, except in a very temporary sense. For although degrees of expertise are a property of bodies, and do not exist externally to that inscription, the same embodied individuals mobilise different subjectivities to situate themselves in relation to the technology. These subjectivities operate in tension with the organisational categorisation of users, and so whilst the term 'super users' both applies to specific members of staff and contributes to the construction of magicians, magicians and super users remain distinct. These discursively produced subjectivities are characterised by their fluid nature, and although there is a parallel in the binary distinction between the organisational categories of super user and other (non users), and the subjectivities of magician and other (inept), the complexity of these subjectivities reflects and constitutes the messy relations between bodies and technologies. This supports the contention outlined in section 1.4, that multiplicity provides a point of departure for understanding both the body and the subject, where the self, formed through a continuous process of self-constitution, is always in flux (Butler 1990b, Turkle 1995). As interviewees mobilise these different subjectivities as they articulate their relationship with GIS, the tensions between them produce both the subject and the technology.

The subjectivities of magician, apprentice and inept correspond complexly to the position of the body in relation to the GIS. Interviewees may not self-identify as magicians, but this subjectivity is embodied through the inscription of expertise on other bodies, which are often placed inside the technology. Thus while the interviewee is often voyeur, dependent on the magician for access to the GIS, the interiority of the machine which only the magician may transverse, is often striking in these accounts. In opposition, feelings of exclusion from the GIS, enforced through practical limitations, such as difficulties in gaining access to hardware, or exclusion resulting from the inability to understand the GIS, are embodied in the form of the inept: the inept is a figure often positioned outside the technology. The apprentice magician appears to have greater mobility, sometimes struggling inside, at

other times excluded. However, these are not rigid mappings, so the competent user might achieve critical distance, while the interior of the GIS in part produces the inept because it provides a space for the clumsy inept body, as well as a source of fascination and fear. It is these complex positionings that reflect messy body/machine relations, where these fluid subjectivities, mobilised at different times by different bodies, both produce the embodied user and the GIS.

4.6 Conclusion

Interviewees draw on the bodily to articulate their relationship with the technology. This is a complex process, where notions of being inside and outside the technology are utilised variously to convey an array of different relationships with the GIS, while this device is mobilised fluidly by users, whose multiple positions are marked by instability. In this chapter, the emergence of three subjectivities from the practice of GIS at SNH were described, though clearly while the magician, the apprentice and the inept illustrate the processes entailed in the formation of user subjectivities, they do not represent a comprehensive account of the possible subjectivities that may have arisen from the utilisation of this technology. They do however illustrate the complexity of the processes entailed in the formation of the embodied user, where complex, fluid subjectivities emerge through the operation of contradictory and complimentary discourses. The processes through which these situated users understand and (re)produce the GIS will be examined in the following chapter.

Chapter Five

The Agency of the GIS Machine

5.1 Introduction

To gaze into the guts of the GIS is as tantalising a prospect as it is enigmatic. As a new technology, a shared understanding of what actually constitutes a GIS continues to be elusive. Operating on many levels, and incorporating a range of different systems, practices and objects, the body of the machine seems beyond the realms of rigid definition (Pickles 1995a, Harvey and Chrisman 1998). Functioning within the remits of inter-disciplinary research communities and diverse commercial sectors, this technology maintains multiple roles, constituting an approach to academic research, a technology, a marketable object and a technical tool. GIS emerges from these diverse positionings as a boundary object, that materialises only through its situated use. Yet if it seems difficult to decide where to direct your gaze, such a dilemma is trivial compared to the problem of knowing where to look from. As explored in Chapter Four, lived bodily boundaries often fail to co-incide with the limits of its corporeal form, and the body, like GIS, is a boundary object which materialises only through social interaction (Marsden 1996). Such an understanding of embodiment implies that the boundaries between user and machine achieve only momentary stability, requiring constant re-iteration to maintain an illusion of solidity. Thus while the material body cannot be maintained as the effective limit of the subject, users and technologies become mutually constructive and mutually disruptive. So effectively, while GIS potentially offers new ways of becoming embodied, the practice of GIS actively contributes to the construction of the body of the machine itself.

The notion of the gaze is invoked in this introduction for two reasons. Partially it reflects the utterances of interviewees, where the visual, manifest in their experience of awe and wonder, emerges as a recurring theme throughout this thesis.

The gaze is however also adopted here to mark my own conceit, my hope to fix precisely what a GIS is. Acknowledging my aspiration through this device equates the gaze with a particular kind of truth claim, which, situated within Western discourses of Science, holds the tempting promise of defining GIS. Yet, in the context of the postmodernist feminist accounts which provide the theoretical framework of this thesis, I recognise that this is implausible. It is an epistemological impossibility, for where the boundaries between machine and body are fluid, and dependent on constant re-iteration, the privileging of academic accounts as stable, denies them the same epistemological relativism which is insisted upon for the technology itself (Hinchliffe 1996). To reject such rigidity, Haraway (1992) proposes *articulation*, where the dominating tendency to speak for objects is replaced by speaking to them. She asserts that objects are not rigidly bounded, but possess a “never finished shape in articulatory practice”. The goal of the analyst thus becomes thinking through the ways in which technologies are constituted through the relations between artefacts and actors. This chapter cannot therefore hope to answer the simple question: what is a GIS? Its body cannot be a mass of wires and circuitry alone: it defies such rigid definition. Such a strategy renders definitive interpretation beyond reach; at the same time it reinstates another kind of politics, one which opposes totalising truth, and restores plurality. The purpose of this chapter is therefore to explore what meanings the interviewees attribute to GIS. In the context of this empirical grounding is the hope of beginning to unfold the possible technological embodiments that may emerge from the interactions between users and GIS.

This chapter is organised into five main sections. Section two outlines interviewees’ descriptions of GIS, exploring how these understandings evolve and are maintained, and the extent to which the machine itself contributes to the way in which it is interpreted. The third section is concerned with the extent to which interviewees attribute sentience to the GIS, distinguishing its active agency from their own. This theme is developed in the subsequent section, which explores how the notion of a separate and sentient GIS is articulated through and supported by the

visual. The fifth section attempts to draw together some of the issues raised in this chapter by exploring the tensions running through interviewees' understandings of GIS. Finally, this chapter concludes by examining the multiple embodiments that emerge for GIS through the complex negotiations between this technology and its users.

5.2 Interpreting the GIS

Interviewees in this study were often eager to adopt a rhetoric which positioned GIS as an effective and flexible data manager, which held the promise of instant access to information. GIS was repeatedly described as a new technology that incorporated impressive spatial data handling functionality. Terry is thus eager to distinguish GIS from other data management software by emphasising the flexibility of the system:

"the way GIS handles data, I mean **the way you can manipulate it** and view data these days, it's a lot different to actually just having a general database of information, and with GIS the way **you can actually overlay so many different levels**".

Terry

His clear enthusiasm is predicated on his understanding of GIS as a unique and useful software. This enthusiasm for GIS, as a technology that would facilitate efficient working practice, was frequently re-iterated by interviewees, especially in terms of its ability to promote ease of access to information:

"it will help Area Officers to access very quickly the relevant bits of information".

Tess

This functionality assumed particular significance for interviewees: utilising the GIS to access data was a task that many users and potential users considered would be the most common function of GIS that they would use in their daily working practices. It was also suggested that GIS would facilitate data sharing. This is exemplified by Richard's comments concerning his interest in making his bird data sets available through the GIS, so that other staff could access them directly, rather than by approaching him:

"I suppose **in the future** if we can get this ... species data on GIS, and available to everybody, then ... I won't need to be asked (for it), because **the information will already be there, and instantly available to them**".

Richard

Richard's description is however situated in his vision of the future, rather than in current practice. The notion that GIS was an effective spatial data handler was frequently based on the understanding that GIS was a developing project within SNH, where the data sets available within the system, and the proficiency of users were expected to increase. This was often accompanied by an expectation that growing sophistication of GIS itself, stemming from both software development and customisation of the product by the LGF, would occur concurrently.

This understanding of GIS was partially supported by interviewees' assumption that GIS represented the most up-to-date, and therefore the most sophisticated and effective software for handling spatial data. Kate demonstrates this as she suggests that GIS technology should be adopted, now that it is "available":

"now that GIS is available ... **we have to become familiar with using the most up-to-date techniques that we can for analysing map based information** so I think that the vision is to make sure that a large proportion of the staff become proficient at using the system so that **they can access information on up-to-date technology, and use it to speed up work**".

Kate

Drawing on notions of progressive historical change, Kate emphasises that GIS is state of the art technology by repeating that it is "up-to-date", implying a causal relationship between "up-to-date techniques" and "up-to-date technology". She deploys this discourse to justify her assertion that it is the most efficient approach available for accessing and analysing spatial data, rather than grounding her claim in personal experience. This conception of GIS thus relies on the discourse of progressive historical change, which emerges in a rhetoric, maintained in both the academic/commercial literature and the SNH training sessions, that insists that GIS is *the* tool for spatial data handling.

The notion of GIS as tool was repeatedly invoked by interviewees, and usually accompanied by the assumption that as a spatial data handling tool, it would be useful. Its usefulness was established by interviewees by referring to a number of tasks, which they considered would be more efficiently performed using the technology, such as searching for information and performing analyses:

"in the analysis of monitoring data or spatial data, **it would be a useful visual tool**, I can see areas where I would have some input ... where GIS would be a key tool".

Similarly, Joan assert that GIS is a useful tool on the basis of its ability to store maps of the area she is responsible for. Having recently completed the process of identifying a long distance footpath route, she suggests that accessing the maps through the GIS would have made her job easier:

"I'm sure if we'd had ... GIS at that early stage it might well have been a useful tool, as it's always a real bore having to get all the Ordnance Survey maps out and y'know, somebody's dog eared the one that you actually want to look at, and somebody's borrowed the other one, and if you've got them all ... on the GIS, then I think **it would have been quite a useful, useful tool** at that stage".

Joan

While Pete suggests that GIS is a useful tool on the basis that it would facilitate the management of complex data sets:

"we're now sitting with a pile of information before we're gonna look at the management of this thing, we have to pull all this information into some kind of structure, and **the obvious tool** to do that is GIS".

Pete

The notion that GIS incorporates a range of functionality which enables spatial data to be handled effectively is therefore utilised by interviewees to support their understanding of GIS as tool.

The tendency to view GIS as the embodiment of 'state of the art' technology was however difficult for the interviewees to maintain, because in the context of this specific implementation, the rhetoric of efficiency was disrupted by users' actual experience of the system. While recounting the ideal of "instant access" to information, interviewees frequently reported difficulties in gaining access to hardware, especially GIS specification machines.³⁰ Once interacting with the system itself, users found the rhetoric of accessibility further challenged, because the experience of using GIS did not conform to their expectations. Instead of providing a flexible means of accessing and analysing data, users discovered the system was slow, in terms of both opening the application and processing speed, whilst small screens, low resolutions and printing facilities mediated against the kind of access they envisaged as desirable. Laura suggests that far from providing instant access to

³⁰ However, as discussed in section 4.2, interviewees who were not using GIS were the most likely to make this complaint. This suggests that hardware provision was sufficient, and it was the perception of hardware sparsity that was the problem. This phenomenon was not based on a 'real' shortage, but on the discrepancy between user's expectations and hardware provision.

data, the system is unsuitable for retrieving small volumes of data, as it takes time for the software to be booted up and shut down after the data has been accessed. This type of quick query was typical at SNH:

“obviously you don’t want to keep going out and in because of ... having to close it down all the time”.

Laura

For Joe, the rhetoric of high quality output was curtailed by the poor quality obtainable from the printer:

“we did have another printer attached to it, but **it didn't work very well**, in fact the colours were absolutely abysmal, so if you tried to produce anything at all complicated it **just looked like a dog's dinner**”.

Joe

While Colin recounts multiple criticisms of the system:

“Initially it was kinda speed, now they’ve upgraded the machines, they’re a little bit faster now. **They’ve only got crap screens**. They’re 15 inch screens, but ... they’re set on low resolutions ... which defeats the purpose. **There’s a limited number of data sets** which have been given the corporate’s hand of approval, so in effect there’s not a lot you can do, and naturally I’m only self-taught, so **I tend to get myself in a pickle, and ArcView has a tendency that you press a button and it goes off and does something and forgets that you’re there waiting**”.

Colin

Colin’s comments illustrate that users often found the GIS inaccessible, not only because the technical specification failed to meet their expectations, but also because, as discussed in Chapter Four, GIS was a difficult software to use in itself. Struggling to gain competency, interviewees occasionally constructed the machine as actively oppositional. Colin’s account suggests that the problem is not only his own lack of expertise, but also the machine’s tendency to “forget” he is waiting. These difficulties combined to challenge the rhetoric of instant access by rendering data inaccessible to the user:

“it - opened up as an interior file in ArcView, it was just sort of [laughs] inaccessible - all the data was obviously away to the left, and this was at the end of the file [laughs] and you couldn’t scroll over to the right part. I don’t know what went wrong there”.

Lucy

Lucy describes a machine which is not amenable to the rhetoric of efficient spatial data handling. Instead, it provides a point of active resistance by going “wrong” and behaving unpredictably.

These comments illustrate that interviewees were not able to impose interpretations freely on the GIS, but were constrained by the machine itself. Thus

while users invest some status in the rhetoric surrounding GIS, they recognise the disjuncture between it and their own experience, and so their interaction with it is mediated by both. Users can therefore both enthuse about the machine, constructing it as an efficient and flexible data manager, whilst rejecting it as time consuming and difficult. In the same way that this ambivalence is central to the construction of the complex user subjectivities discussed in section 4.5, this process has the effect of constructing different understandings of the machines. This interaction appears to echo Haraway's (1988) notion of symbolic conversation between humans and machines, as the GIS is not passive, but active in its shaping of itself and others. It is co-constructed through its interaction between the discursive and material possibility. Such conversation recognises the agency invested in the known, that is the artefact, as well as the knower, and thus to seek the GIS becomes an intricate task for both the user and the social theorist.

ANT provides a useful framework for understanding this process by emphasising how particular social situations and human actors 'enrol' pieces of technology into complex actor networks. By associating different aspects of the social, such as the GIS, the users and their bodies, the organisational context of SNH and its working practices, this technology, which potentially has contingent and diverse effects, emerges in this specific social context through inter-related human and technological agency (Thrift 1996). Blurring the boundary between actors and artefacts, agency becomes a relational process, and thus to privilege the actions of the human actor, when the category itself is demonstrably not consistent or internally intact, lacks credibility. Understandings of GIS at SNH therefore emerge from the relations between the agency of users and the machine. Users' understandings are thus (re)produced both through the discursive construction of GIS as an efficient spatial tool, and the machine's ability to resist this interpretation. So factors, such as the perceived lack of access to hardware, and the difficulties entailed in using this software, constrain the ability of discourse to interpret it. Dissolving the boundary between technology and the subject reveals the agency of the machine, for like the users' bodies, the GIS is not indifferent to signification (Butler 1990a).

The work of Haraway (1985, 1989, 1992, 1997) has been central to the rejection of reductionist accounts which deny all agency except that invested in the human subject, as discussed in section 1.2.2. Instead, she contends that objects materialise through the specifically situated effects of collectives of actors, be those actors human, organic, or inorganic. Theorising the object as the product of co-construction between variously situated actors rejects a polarity which views it as either completely inside or outside of discourse. That is, while such objects of knowledge do not pre-exist, but emerge through discursive processes, neither are they ‘pre-discursive bodies’, which exist only to validate or invalidate discursive practice. The GIS is better understood as a *material semiotic node*, which actively participates in its own construction. This concept acts to disrupt the notion of artefacts as transparent screens, upon which people’s cultural understandings may be projected. As an object the GIS is dense, with the inherent ability to resist, enable, engage and constrain its interpretation. It acts and signifies, and like all actions and significations, it does not provide a set of unequivocal facts waiting to be observed, but it does suggest the limits of discourse. So the GIS, as an object of knowledge, is not reducible to ideology, and as a particular material semiotic actor it has “specific kinds of solidity in the apparatus of bodily production” (Haraway 1989: 311) .

5.3 The Agency of the Machine

The interviewees draw on a number of different and sometimes contradictory constructions of GIS in order to mediate their interaction with it; however the tendency to depict the GIS as an active agent is prevalent in this study, and indeed has been identified in studies elsewhere by other academic commentators. Edwards (1995), for example, adopts the term ‘cyborg discourse’ to describe the increasing prevalence of discourses which construct the computer as a ‘self’, that is, as intelligent, active and independent. This section explores the attribution of agency to GIS by examining users’ descriptions of interacting with the technology, and their views about the future role of GIS in SNH. Certainly when interviewees describe their interactions with the GIS, they often adopt a language consistent with

communication with a sentient other. It becomes appropriate or 'naturalised' for Anne to ask:

"what does it look like on the computer, **what's the computer telling us?**"
Anne

The computer is credited with sentience: it tells the user. This understanding is also adopted by Lucy. When her data were input into the system, the digital format highlighted an inconsistency in her data set:

"It's nothing I noticed, **the GIS pointed, pointed that out**, but it's just another hiccup, it will take another half hour to sort out, and all these half hours add up".
Lucy

She suggests that this constitutes the GIS 'pointing out' an error. This interpretation or understanding has the effect of creating a disjuncture between the activity of the machine and the user. She constructs a distinction between the GIS finding it and her 'sorting' it out. Her activity is predicated on the GIS 'pointing' out an error, rather than viewing the act of discovering the error as integral to the process of data management and analysis, which would enable her to attribute agency solely to herself. This quote was previously discussed in section 3.6, where it was argued that Lucy's frustration stems partly from the inability of the GIS to cope with this error, as she can. This arises because without the GIS, Lucy wouldn't have discovered the error, or it would not have been such an important problem if she did. It is the GIS that seems to 'mind', not her. The GIS imposes a different agenda, prompting Lucy to acknowledge the agency of the machine.

This tendency to separate the activity of the machine and the user is extended in Sarah's description of the planning proposals system she hoped to develop on the GIS. A computerised database system was already in operation, which allowed details of each planning application to be inputted by the Area staff dealing with the case. Sarah envisaged that by linking this system to the GIS, spatial analysis of planning applications would become possible, enabling overall strategy to be informed by these outputs:

"I've asked for a grid reference to be filled in anyway [on the planning database] ... when that is done, **it will find itself on GIS automatically**. So it will be the Area staff themselves, every time they get a new application, and they fill in the details on it, that it **will record itself on a database, record itself on GIS, and it will generate the paper work**, the acknowledgements and the letters and so on and so forth, and also act as a

checklist and guidance to help new Area staff in dealing with casework, cos **it will show them all the things they need to do**".

Sarah

Sarah's account implies that the computer, albeit implicitly programmed to perform this function, becomes active in the management of staff. So despite the fact that the system requires input by the Area Officer in order to generate the paper work, it is the machine which is constructed as managing them: the GIS will "show them all the things they need to do". Similarly Nigel, who has never used a GIS, imagines the interaction as a series of questions directed at the machine itself:

"I don't care how it works, all I want to be able to do is yeah, essentially basically draw an outline of the area, and say what's in that? **Tell me everything I want to know about that?** Has it got badgers? Has it got ancient woodland? Has it got any notable species of any sort? What habitats are there? Has it got any rights of way? **Thank you very much**".

Nigel

Nigel attributes such a degree of agency to the machine that it seems appropriate for him to thank it, though clearly such expressions of gratitude are normally reserved for sentient others. The interaction which Nigel describes is reminiscent of a conversation with a colleague, rather than data interrogation using a tool, and the computer is anthropomorphised through this process.

It appears that in these interactions with GIS technologies, (whether that interaction is material or abstract), interviewees construct the GIS as active other. Although Sarah explicitly acknowledges that, in her vision of the planning system, the data has been input by the Area Officer, and Nigel doubtless realises that his badger, ancient woodland and species data has been surveyed, interpreted and inputted into the system by a human agent, the mediating position of the GIS seems such a potent one, that the GIS is attributed agency. This is because, although human agency is implicit in the functionality of the GIS, it is so dispersed that the technology becomes the central focus of activity. By fabricating an environment in which the actions of different human actors are amalgamated, it provides them with new meanings by relocating the relationships between human actors and their actions. As it generates products such as complex overlays and paper work, which would not have been possible without it, the GIS emerges as agent, and the technology becomes more animated than the individual human agents associated with it (Lyons 1994). Clearly Sarah and Nigel could describe this interaction

differently, for example, in terms of data input or interrogation. Instead the GIS emerges as an active other, which appears to act independently of the operator, and in many respects provides the agenda. So Nigel's expectation is that the machine will not only provide the answers, but will be able to establish what "everything" that he wants to know is. Such remarks separate the GIS from its users, suggesting it possesses its own agenda and active agency.

A similar conception of GIS is discernible when interviewees consider how the GIS strategy will be developed within the organisation. Drawing on the discourse of progressive historical change, interviewees in this study were almost exclusively positive about the development of GIS. Relying on the assumption that GIS would improve over time, pessimistic predictions were usually reserved for factors specific to SNH's implementation, for example, the perceived reluctance of management to invest in hardware, or to mount appropriate data sets. The increasing sophistication of the software, imagined outside of SNH's specific implementation, was assumed, while the tendency to construct this as a process operating outwith its socio-political environment was often implicit. Thus Rose, commenting on low levels of uptake within SNH, suggests that this is because the current software lacks sophistication, but is never-the-less optimistic about the future:

"I think people would have pretty high expectations of something like this, and will be disappointed perhaps, but **the technology seems to be moving so fast that it will catch up eventually**".

Rose

Similarly, Terry, who is already impressed by current functionality, is convinced it can only get better:

"**It has so much potential** of what can be done with it ... even these days. Even though it's ... becoming quite a common thing, I still think ... **there's so much further it can actually go**, as with the advent of ever increasing new technology, ... the rate of technology change as well, I think, probably within the not too distant future, we'll see GIS radically change".

Terry

Rather than envisaging software development as the product of situated designers, working within the constraints of an environment dominated by major vendors, the interviewees seemed to conceptualise GIS in particular, and technology in general, as

having its own momentum.³¹ Thus to Terry, the development of GIS seems to be something which ‘we’ passively observe, rather than contribute to.

Establishing a metaphor of temporal movement, computing technologies were constructed by the interviewees as developing not only independently of human actors, but also on a completely different time scale. Interviewees were prone to extend the metaphor, envisaging computing technologies as moving so rapidly that their development was perceived outside the context of the lived experiences of interviewees. Thus earlier systems were described as “dinosaurs” or “ancient”:

“it’s an old database and it’s an **absolute dinosaur** to get stuff out of”.

Pete

“We’ve just had it changed, because it’s an old data set. It was originally in this **ancient** thing, which was really cumbersome, it wasn’t user friendly, nobody could use it”.

Alan

The disjuncture between the rapid pace of technology, and the potentially ambling user, seem to hold the threat of effectively thrusting the interviewee back in time to the “Dark Ages”. So Melanie, responding to a question about her views on the increasing computerisation of working practices in SNH, defensively replied:

“well we are hardly going to stay in the **Dark Ages** for ever”.

Melanie

As such, interviewees established an independence between the technology and themselves, so the constantly progressing technology was something that had to be pursued, either at a personal or organisational level. Thus Terry, asked whether he reads GIS Forum, an internal newsgroup about GIS in SNH, responds:

“yes, yes - I dip in now and again to **just try and keep up** with the kinda buzz of what’s going on”.

Terry

His emphatic reply suggests that even within SNH the rapid development of the system requires constant monitoring on his part. Rose also invokes a metaphor of movement as she reflects on whether GIS should be adopted by SNH. Her concern is

³¹ This tends to shed a different light on concerns in the GIS literature that the increasing concentration of GIS software development in the hands of a few vendors will prompt a disjuncture between vendors and their clients, in that users are apt not to consider the vendor at all. It does not however dispel the concerns that this material imbalance of power might produce, for example, US vendors producing urban software which is entirely unsuitable in European contexts (Crampton 1995).

that other technical developments are being increasingly embraced by partner organisations:

“we've got people in Community Councils and community projects that are already on email, far, far **ahead of SNH**. Y'know ... tiny organisations, and that's the way they're communicating”.

Rose

Rose is aghast that SNH may be left behind, as the technology moves relentlessly on, despite her critical engagement with GIS in the rest of the interview, in which her status as an independent project manager, led her to reflect carefully on whether GIS constituted an appropriate technology for her to adopt at all. The prevailing sense suggested by these quotes is the fear of being left behind, enabling an active, independent and rapidly moving technology to evolve, which is vitally embodied by its own agency.

5.4 Looking for the Machine

Interviewees frequently associate the GIS with wonder. This section argues that this arises from two distinct processes: the construction of the embodied machine as spectacle, and the wonder derived from the opacity of the computer, where what is hidden functions to construct the machine as an active agent. This section concludes by suggesting it is not simply wonder that contributes to understandings of the machine as sentient. The material body of the machine was often described by interviewees as spectacle. Thus Sally, enthusing about her initial contact with GIS, invokes its corporeal form:

“when it came in and John was the guy that's using it, and has **the screen on his desk** **I want to see it ... so aye, I mean John, as soon as it came into the office, I wanted to see it, just to actually see it, cos I had heard about it, but other than that**”.

Sally

Sally describes her enthusiasm for GIS, (though her obvious excitement is more discernible on the audio data,) by emphasising her impatience to “see” the GIS. The spectacle of GIS is produced through its corporeal form, which becomes obtainable through the visual. The physical hardware - the screen on John's desk - provides a focal point for her excitement and awe, and the body of the machine is integral to her expression of wonder. As discussed in section 3.3, interviewees tended to be in awe of the technology. As a technology of realist representation, it is perhaps obvious

that GIS would promote wonder through the visual medium; however it is physical hardware that Sally suggests she has seen, that is, the screen itself, rather than any data analysis products. Sally's wonder for the machine is thus distinctly different from the wonder expressed by interviewees for GIS products. It is not based on the spectacle that the GIS initiates through its utilisation, but on the machine itself.

The physical hardware on John's desk would have comprised of a GIS specification machine, and as specialist digitising and plotting facilities are situated elsewhere, it would have appeared similar to the computer on her own desk. Clearly however Sally initiates a distinction between this PC and others. The hardware on which the GIS is installed becomes the focus of interest for her: it provides the GIS with a corporeal form. Similarly, Rose, explaining how she learnt GIS during her undergraduate degree, invokes the visual as a means of establishing her level of contact with the system:

"we just learnt about it. I know some postgraduate students were doing it, cos I had a friend that did ... some actual work on it for DoE - **I don't think we ever got to see**, I don't think we did, we learnt about it, but **I don't think we ever saw it**".

Rose

Implicit to this is the notion that the machine has a physical presence, that there is something to see. While for Bill, his awe for the system is extended to the operator:

"**see I've never, I've never even seen the machine**, I've never, I don't know ... who's the operator".

Bill

The GIS therefore appears to be held in wonderment, while this is to some degree predicated on a corporeal imagining of it.

The relationship between wonder, as it is (re)produced through the visual, and the GIS is however a complex one, as to some extent it is based on the notion of what is hidden. Stone (1995a) suggests that the plastic casing, which obscures the material components of the computer, provides a boundary between the sanitised and seamless outside, and the mysterious and messy innards of the machine. Certainly vendor's usability trials often stress the importance of providing a prototype in a box, because this implies that the hardware is finished, complete and functional, even if this is not the case (Woolgar 1991). This strategy acknowledges that the plastic casing constitutes both a literal and metaphorical 'black box', which is instrumental

in forming the relationship between user and computer. Stone suggests that a desire to rupture this boundary between the inside and outside, in order to see the dishevelled innards, results from this material construction. Certainly the insides of the machine, and what occurs there in terms of processing, appears to interviewees as positioned beyond their field of vision, and provides a site of puzzlement:

"I did some ... evening classes about ... programming in BASIC ... it was never used commercially, it was always ... people doing things at home, but I just don't, I wish I knew more about what goes on ... inside the box ... You probably don't need to for my job, but I just feel that if I did I might ... not need to phone up the help line people quite so often".

Carol

Carol's tentative wish to know the "inside of the box" is intimately related to her discomfort in not understanding it. In the context of learning to program, she would not have to literally delve into 'the box' with a soldering iron; however she adopts the metaphor easily, and rather than talking in abstract terms about how programming languages function, she embodies the machine, invoking the imagery of a forbidden inside.

Interviewees' sense of wonder arises in part from the tension between their wish to gaze into the machine, and their inability to do so. This stems from the material opacity of the machine itself. As discussed in section 3.4, users are unable to view the machine operating, and therefore the processes by which it generates output become mysterious. Arguably such wonderment also produces an active embodied GIS. This agent, which responds to questions, points things out or even forgets about its user, arises in part from its computational opacity. Social theorists interested in human computer interaction have argued that the opacity of the computer challenges the distinction between artefacts and intelligent others (Suchman 1987, Turkle 1984). Presented with a machine which responds in real time, (as opposed to batch processing), and whose functionality is beyond the vision of the user – they cannot see wheels turning, levers moving – it becomes increasingly difficult to classify the computer as a tool, and easy to personify it as an intelligent other.

It is tempting to interpret digital artefacts as a materially unique phenomenon, where the complexity of systems seduces the intelligent human agent into crediting the computer with sentience; however this explanation holds the danger of both excluding importance precedents which might illuminate process and organise resistance, whilst it also initiates a mechanistic nostalgia, that distorts, rather than promotes, understanding. Cosgrove (1990: 349) suggests that in the Renaissance period, machines were frequently understood as wondrous and mysterious, because “vulgar people”, failing to grasp the principles of how they operated, were apt to regard them as “marvellous or magical”. Certainly this conception of technology is apparent in interviewees’ accounts of GIS, where magic and wonder emerges as an important theme. This does not imply that the interviewees are naïve or misguided. Their awe is not based on a literal belief that the GIS is magical in a miraculous sense. The processes by which it functions are however inexplicable to them, and this contributes to their construction of it as active, and to their understanding of themselves and others; creating a range of different subjectivities, as explored in the section 4.5. In this sense, the machine is embodied with agency through the operation of magic, mystery and wonder.

This does not imply that the GIS gains its agency purely from the wonder of human agents, for its animation does not arise purely from the plausibility of an illusion. The wonder is not a chimera, but also predicated on the material effects of the machine, where the GIS contributes to constructing the relationship between user and machine. That is, the machine is attributed agency because it fundamentally affects human agents. Carol, for example, suggests that although her disquiet is partly based on her fear of the mysterious ‘black box’, she is also aware that by using the GIS to analyse data she is initiating a materially different process from analysing it using more traditional methods:

“I suppose **there’s an element of ... black box fear where ... if you don’t quite know how [the GIS is] doing what it is doing you might be generating completely spurious results**, where as if you were doing it yourself by drawing something on a map and ... calculating the area or whatever, you’d ... have a reasonable supposition that it was actually correct and meaningful, where as I think you can get carried away with the technology and start to generate ... wonderful looking ... maps and charts and graphs and all this, which may be generated from ... pretty ropey data in the first place”.

Carol

Similarly, Melanie suggests that even if the computer produces the same results as more traditional methods, analysing the data ‘by hand’ provides the analyst with a greater understanding of what the results mean than by using a computer to produce analyses:

“[If] you spend longer sometimes analysing things, **you perhaps have a greater understanding of the primary data, than if you’ve just asked a computer to do the analysis** without understanding where it’s made it’s answer from”.

Melanie

For Carol and Melanie, the system’s active agency seems to arise from both its computational opacity, and the knowledge that it has fundamentally contributed to how they conceptualise their data. Thus Melanie seems to consider that she has “asked” the GIS to perform an analysis, because it is different from her having done it herself. The different relationship between data and human agents is also apparent when interviewees considered confidentiality. In pragmatic terms, interviewees frequently suggested that it was more difficult to control information in digital form, but there was also an awareness that data sharing mediated by GIS fundamentally altered the relationship between people and data:

“there’s a whole range of different confidences if you like, and all of them are important, ... what they would tell you in a meeting confidentially is important, and they wouldn’t put on a machine ... what they write in a letter they might be willing to write to SNH, but they wouldn’t want to put on a public machine”.

Carol

The agency of the machine is therefore based on its ability to make a difference. It initialises other agendas, and the machine emerges as active agent through a number of different processes, which inter-related, contribute to each other, and to the construction of machines and users.

5.5 The Machine/Human Border

“I can see the potential [of GIS], but I think it’s realising the potential that is gonna be a problem. I think it’s gonna cost a lot of money, and I’m not convinced that there’s enough people who would actually use it, and - but I might be wrong”.

Jaik

If the machine is considered as progressing separately from its users, this construction is far from stable, and is delicately balanced on those who interacting with it, construct this sense of agency. Jaik’s concern that the potential of GIS might not be realised because staff will fail to adopt the technology juxtaposes Rose’s

assertion, discussed at the close of section 5.3, that SNH cannot afford to be 'left behind' as smaller organisations embrace the digital age. Yet although Jaik and Rose present opposing viewpoints, they both rely on the discursive construction that people and technology are intimately linked. The GIS may be constructed as active, but this agency is predicated on the actions of people. This tends to disrupt the concept of technology divorced from human agents, for, although it is possible for interviewees to construct the technology in such terms when it is considered in the abstract, its utilisation necessitates consideration of the user, who like the machine, possesses the agency to resist, enable and constrain.

Recognising this, interviewees also positioned themselves centrally to the practice of GIS. So Melanie, despite her tendency to describe GIS as having its own momentum, as she voices her fear that SNH can hardly stay in the "Dark Ages", she also locates herself as an active agent, who will use the GIS:

"we're all going to have GIS facilities available in the office, and the Phase 1 habitat data for West Lothian is already GIS based, so **the sooner I can operate GIS the potential for actually using data sets and using local data sets is quite, quite great**".

Melanie

GIS emerges from these quotes as embedded in its users, because it is in its interaction with them that it gains meaning. That is not to say that its users entirely construct its meaning, or that it has no meaning outside its use; however as GIS is a boundary object which materialises through performance, that is by the reiterative power of discourse to produce the phenomena it regulates, its utilisation becomes one medium through which it is constructed (Star and Griesemer 1989, Butler 1993). The materiality of both users and the machine thus function to constrain and enable those meanings which can be attributed to it.

This initiates a potential conflict between the discursive construction of GIS as the spatial management tool and understandings of it generated by interaction with the system. This conflict impacted how interviewees expected GIS to effect working practices within the organisation:

"I would hope that ... it would induce greater use of standardised data, standardised survey techniques - standardised ways of just handling data. I would hope that that

would come out of it, which would be good, ... we are still in a situation where you're taking data which is taken from different surveys and using techniques or whatever, and I would hope that changes to have a more unified way of looking for some standards

In the short term, I think that people will stick to their old working practices. I suppose in the long term ... there is hope.....".

Duncan

"I don't think we can rely on (GIS) too much to er, to try and catapult us into the second, the third millennium, it won't, at least while you're dealing with people".

Colin

Colin's contention that GIS cannot be expected to thrust users into the next millennium initiates an opposition between people and the technology, for while the agency of the machine is invested in its potential for providing the opportunity of new working practices, the user is critical to activating this process. The embodied GIS thus emerges as cyborg, forged from the alliance between user and machine.

Interviewees conceptualised the relationship between the human user and the GIS as mutually productive, where the GIS would not only effect the working practices of the organisation, but where its adoption would impact the GIS itself. It was frequently argued that as GIS became embedded in current practice, greater numbers of potential users would become aware of it, and its use would therefore become more widespread. Concurrently this would promote investment and development of the software, and as systems became refined and standardised as good practice, it would be increasingly difficult for users to resist the system. Thus a self-perpetuating loop of increasing use would be created:

"it's very noticeable that other bodies such as the ... Forestry Authority are using GIS more and more in their own systems, so I think as it **becomes more widely used for different applications throughout the country, I think there will be more enthusiasm for using it**, and therefore ... **it may well be that as more people use it, it will become easier to use**. I don't know if systems can be refined, so that ... certain ... stages become perhaps more streamlined. I don't know if that can be done or not, but I'm sure it can".

Joan

This promotes a far more complex understanding of agency than one which considers GIS alone as inherently progressive and active, for here agency is invested partly in the machine, and partly in the user. The boundaries between them, although still discernible here, are mutually constructive. Thus as "more people use it", it is perceived by interviewees that the GIS will transform into something that is easier to use, while concurrently, as the GIS becomes prevalent, it changes the positions open to potential users. Only gaining temporary stability in its interaction with active

human bodies, it changes not only them, as discussed in Chapter Four, but itself. In this context, its spread through the human network redefines it, and continuously displaces its position in society, and in circuits of power.

This relationship between GIS and users is suggestive of the limits of each, where both are positioned as active, inherently possessing the ability to disrupt and contribute to the construction of each other. This complexity often emerged when interviewees tried to describe their relationship with the machine. As Edwards (1995) contends, 'cyborg discourse' has entered our language and the tendency to speak of (or to) the machine as active other is prevalent; however the processes by which agency is attributed to the machine are complex. Although interviewees frequently described the machine as something to which it was appropriate to address questions, and so forth, when these statements are contextualised by an examination of the sorts of phrases which are employed around them to describe GIS, they often reveal far more tentative understandings of the technology. This appears to reflect the interviewee's ambivalence about where agency actually resides. This is apparent as Rose explains why she elected to use GIS to analyse data in her coastal zone management project:

"People have used GIS for coastal zone management before, and **it just seems the right kind of tool to use** for it, because it has all the right, y'know, it's overlaying lots of different aspects of data, **it can solve problems**, all these kind of things. It just seemed ... that it would be a very useful tool, and it's just grown from there really".

Rose

Rose recalls the familiar GIS which actively solves problems, but this is countered and contextualised by her positioning it as a tool, whose validation stems from it having been chosen by other people, as well as herself. This has the effect of simultaneously objectifying it as an artefact which gains status through human judgement, and enrolling it as a sentient other, which contributes to her project by actively solving problems.

Similar tensions are often apparent when users describe using the GIS. Instead of constructing a disjuncture between the active machine and passive user, Danny's account of accessing data on the GIS illustrates their integration:

"that would be something that **I would be hoping perhaps to use the GIS system to do.** To sort of go off on a tangent about that, **I mean one could imagine something like - asking the system, they want, you want to know, somebody comes along and says I want to know where all the mineralogical sites are**".

Danny

Danny stumbles with indecision, seemingly uncertain as to whether it the machine, himself, or the member of staff asking the question that is active in this scenario, or a combination of these. His initially authoritative hope to 'use' the GIS is replaced by a more tentative 'asking'. Judy's account of accessing data on the GIS reflects similar ambivalence:

"if you were already sitting at a PC then you could just transfer from your database, and go and plug in that grid reference, ... **click on the GIS button and instantly type in your grid reference** and ... get straight into that, and **let the system find out** what information there might be".

Judy

Judy seems to assert an active agency for both the GIS and herself. She carefully describes the details of her own input, before reasserting the agency of the machine, which she suggests is allowed to find the information she has requested. The uncertainty seems to stem from confusion about who exactly is performing the operation. Her account implies that the task is performed through the efforts of both the machine and the user. She does not perceive the detailed account of her own actions as providing the data she requires. Rather the data output results from a collaboration between her initiating the appropriate commands, and the GIS 'finding' the information.

The location of agency therefore has a measure of fluidity in terms of how the interviewees understand their interactions with GIS. Woolgar (1991) asserts that all human computer interaction is a product of the agency of both, for while the software developers prescribe a range of possible interactions, both user and machine are able to resist. The user is able to interpret the software in ways that the designers could not envisage, while the machine is able to display functionality that was not intended, that is, to go wrong. The relationship between users and GIS, as described by interviewees in this study, suggests a more subtle analysis of the ways in which agency is distributed is necessary. Instead of seeking agency solely in the oppositional relations between the intentionality of designers, and the opportunities

for resistance for both machines and users, these accounts imply that the distribution of agency arises from the relationship between machine and user, as each is constructed through their negotiations with each other. Although unintended functionality provides an obvious arena of agency for the computer, suggesting its own ability to resist, the interviewees in this study appear to have far more complex understandings of GIS. As such they are apt to attribute agency to the machine regardless of whether it is performing within its prescribed operating parameters or not. This arises from interviewees' tendency to construct boundaries between their own agency and that of the GIS. So Judy, in her description of accessing data, separates her activity from that of the machine, rather than perceiving the output obtained as a seamless conclusion to her own active use of the technology.

Interviewees consider agency to be located potentially in both the GIS and the human agent. Their understanding of such agency is fluid, where its location between the machine and body is not rigid, but, changing with context, open to negotiation. Gary illustrates this process as he explains his concern that SNH will become overly reliant on GIS:

"If you get to the stage where the tail wags the dog, then the, I think there's something seriously wrong, cos that is when you start to think that, **if you get to the stage where the tail wags the dog, where GIS wags me**, then you start to, I would imagine you start to lose perception of the whole thing you would get GIS responses to problems".

Gary

Gary imagines his relationship with GIS as one of active opposition, where he is compelled to be proactive in order to preserve his own agenda (and subjectivity), lest the machine takes (him) over. The boundary between the agency of the machine and the human is far from stable in this account. For Gary, the agency of the GIS seems to offer the potential danger of taking over his physical body: the GIS might 'wag' him. This analogy between GIS and its user, and a dog and its tail, has the effect of dissolving the boundary between the embodied GIS and the embodied user. It seems that for Gary, his use of GIS problematises the distinction between himself and the technology, both in terms of where agency is located, and in terms of lived bodily boundaries. In the same way that it doesn't make sense to think of the tail as separate from the dog, the implication is that when he is using the technology, the boundary

between himself and the machine dissolves – one cannot be a GIS user without a GIS. Thus, while the boundary between the human agent and machine is destabilised, the location of agency becomes a matter for negotiation.

This is exemplified in the following account, where Sally describes the effect of networking technologies:

“It’s not a big brother watching you, but it’s the staff, they expect more of you ... and it’s there, and you can use it, somebody can get an answer like now, and I think a lot of people probably feel afraid of that, because ... it tends to push you along a wee bit ... that you go faster than you maybe want to go”.

Sally

Sally is ambivalent about where agency is located. Her opening phrase that it is not Big Brother disavows the powerful gaze of the GIS. Yet although she asserts that it is *not* the machine that has created the frightening situation, but the perceptions of other staff, it is unclear as to whether the ‘it’ that tends to push you along is the network or the staff. In many respects the distinction isn’t possible, for the machine without the expectations of the staff, or the staff without the technology which has enabled these expectations, would not create this situation. The increasing activity of Sally is predicated on the alliance between humans and machines, and thus being mutually constitutive of each other, the boundary between them is vague. They merge as a distinctly new cyborg persona. So where the GIS and the human become in some respects indistinguishable from one another, to consider agency as confined to either one of them, is fundamentally misconceived.

5.6 Tools, Toys and other Geographic Information Systems

“I mean it might make ... searching for information slightly easier, but it’s not going to modify anything in any significant way at all, because I mean we will ... maybe using it as a tool, it’s not going to doing the job for us”.

Judy

Interviewees frequently invoke the notion of GIS as a tool to structure their relationship with it. As discussed in section 5.2, the term ‘tool’ is adopted easily by interviewees, and the GIS is constructed as a powerful and flexible piece of technology that will facilitate efficient working practice. Certainly the phrase tool was the most common description applied to GIS in the course of the interviews;

however a careful analysis of how the concept of GIS as tool is mobilised reveals that this understanding is also invoked to disavow understandings of GIS as a tool. This reflects the complex, ambivalent understandings that interviewees have of GIS. Judy, for example, invokes the notion of GIS as tool not only because she considers its data handling functionality useful, but also to imply that it is *merely* a tool that will facilitate the work of staff, rather than performing it, and the term tool is adopted here to disavow other embodiments. This process is also apparent in Sarah's account of GIS' usefulness:

"I think there's a limit to how much you can record on a computer, because **computers aren't experiential, you're looking [laughs]**. They can only hold the information, and I'm quite happy that we use it to store information and then make judgements about them. **I appreciate that you can't - also that you will never do everyone's work, ... you've still got to use your head, it's just a tool**".

Sarah

Sarah's hesitant explanation of the limits of GIS concludes with her suggestion that it is "just a tool". She utilises this phrase to express views on GIS which she finds difficult to articulate. Her appreciation of what you can't (do with GIS) is not voiced, while her explanation of what one is looking at ends enigmatically in a laugh. Her conclusion that GIS is "just a tool" disavows that it is something more than that. Yet Sarah's suggestion that not everyone's work can be achieved, presumably, with the GIS, and that the human head is still necessary, implies that the technology can do some of the work. Her defensive suggestion that GIS "only hold information" is a response to an implicit argument that it is something more than that.

Colin also introduces the notion that GIS is "just a tool" to explain why he is cautious about colleagues' enthusiasm for the technology:

"It's just a tool, it's not - I mean I had a theory about GIS apologists, who **live and breathe** and they think it's kinda the centre of the bloody universe, y'know, where by GIS is actually the gateway to information, you go through the GIS to the database, to the wordprocessing to the image library, to the internet, and I think that's complete garbage, it might happen in many years to come, but it's not going to effect a bureaucracy like, a public administration outfit like SNH in the short term".

Colin

Colin has similar difficulties in expressing exactly what GIS is not, and his sentence, like Sarah's, is left unfinished. He acknowledges an active GIS, which is animated through it users who "live and breathe" it, and thus introduces the notion of GIS as cyborg, vitally embodied as a site of agency through the facilitating technology and

the actions of human users. Here, his insistence that it is merely a tool is presented as an argument against the “GIS apologists”; however his suggestion that “it might happen in years to come” hints that he understands GIS as a technology with the ability to transform into something which is more than a tool. Anne’s account of how GIS should be understood by staff in the department she manages is more explicit in its implication of what else GIS might be:

“it would literally only be a tool, and ... we’d be very, very much of the mind to make sure that staff didn’t think that they’d just do the LGF **three dimensional trick**, press the button and oh yes, that’s tells us what it looks like, and that’s where I can see it from, oh well I can write a report now, no, it wouldn’t be like that at all, it would be very much ... an additional tool to actually doing any other form of appraisal”.

Anne

Anne suggests that GIS is potentially more than just a tool. Invoking the notion of magic, she acknowledges that the GIS “trick” of interpreting the data for the analyst potentially enables the operator to perform magic. Insisting on the GIS as tool, she contrasts this embodiment with an understanding of GIS as a magic wand. Embodying the GIS as tool thus functions multiply: it both supports the notion of GIS as a ‘state of the art’ data manager, and acts to disavow GIS as an emerging cyborg, an active agent or a magic wand.

GIS emerges from these complex negotiations as multiply positioned. It is interpreted as a tool, and sentient other, and these positions function fluidly, so that the same interviewees are able to adopt multiple interpretations. This complexity arises from the manifold relationships that interviewees hold with the technology, for as ANT suggests, technologies have contingent and diverse effects through the ways in which they are linked into human and technological agency, and while agency is fluid and messy, it (re)produces a multitude of differently embodied GIS (Graham 1998). Judy, describing how she will use GIS in daily tasks, mobilises the notion of GIS as both tool and toy:

“There is life out there you know..... I mean I enjoyed it and **I’m quite happy to use it as a tool or a toy**, but ... as a tool I would use it much more often - but there’s no way on this earth you’re getting me sitting in front of a screen all day every day, regardless of what’s on it”.

Judy

Situating her use within working practice, she draws on an understanding of GIS as tool, that provides the focus of her interaction with it, as it facilitates her ability to

fulfil her primary function within the organisation as an Area Officer. Concurrently she acknowledges her pleasure in using GIS, which enables her to interpret the system as a toy.

GIS is multiply positioned, while its meaning is liable to change not only with the perspective of the human agent, but over time. Terry illustrates this process as he draws on the example of the general network to explain how he thinks attitudes to GIS will change over time:

"The SNH network, when we got installed ... **it was a new toy** to most people, ever since then, ... people have been more and more using it to it's potential, storing information on drives, making information communally available and people see the potential for that, and now, when the network goes down, people - hands up - oh no, the network's gone down - **my tools are taken away from me, I could do nothing, I feel inadequate, blah, blah, blah, and I think if, if GIS was taken away today, there would be this little core set of people who would wear the black arms and mourn** but I think generally ... people think oh well, ... no big deal. As time goes on, as they see things, that perspective will change".

Terry

According to Terry, the network was initially a 'toy', but as time as passed, it seemed to metamorphose into something much more. Rather than being a simple artefact, in Terry's description, it has a organic quality, which enables it to transform. It appears to have become animate. While for those who already feel the same way about GIS, it is distinctly alive, so that its passing would make ritual mourning, usually associated with the death of sentient others, appropriate. The GIS lacks stability, and thus through a complex array of complimentary and competing discursive structures, it emerges simultaneously as tool and toy, and sentient other.

5.7 Conclusion

GIS emerges from interviewees' understanding of it as a complex object, where its status as a powerful and flexible spatial data tool both informs how GIS is practised, and acts to disavow other positionings. This arises from the messy operation of contradictory and conflicting discursive structures, which enable interviewees to situate the technology within discourses of progressive historical change, even as they recognise this conflicts with their own experience of the technology. The sentient machine emerges from these ambivalent understandings,

predicated partially on the material difference that such systems make, and partially on the wonder and fear that GIS produces. This embodied GIS challenges the human/machine border, creating a cyborg melded from the GIS and user, and (re)produces diverse embodied positionings for the technology. The effect of these multiple positionings, which emerge through their interactions with multiple bodies and subjectivities, as GIS is practised, will be explored in the following concluding chapter.

Chapter Six

The Magician and his Apprentice

6.1 Introduction

“Stories are not ‘fictions’ in the sense of being ‘made up’. Rather, narratives are devices to produce certain kinds of meaning. I try to use stories to tell what I think is the truth - a located, embodied, contingent and therefore real truth”.

Haraway 1997: 230

This thesis has attempted to narrate stories about how GIS is practised at SNH. It has proved a complex tale: the plot, ridden with twists and turns, is held together only loosely by characters who have proven largely elusive. The GIS emerges from this narrative as an enigmatic object: the embodiment of ‘state of the art’ technology, a mundane tool, a sentient other, a spectacle. It is a boundary object, where its numerous guises are embodied only momentarily, and like its users, who emanate from multiple subjectivities, it lacks stability. Chapter One closed by posing some questions that this research, located within a postmodern feminist account of science and technology, might hope to answer. It sought to address the issue of how the situated practice of GIS constructed both the technology and its users, endeavouring to access these debates by examining how particular users made sense of, or understood, GIS. It also posed the question of how these interactions with this technology might inform and contribute to users’ understanding of themselves, both in terms of embodiment and subjectivity. In the context of the feminist framework adopted in this research, how gender operated and contributed to all of these processes assumed central significance.

This final chapter attempts to revisit these questions, in that it searches for a plausible story that might do justice to the messy complexity suggested by interviewees’ accounts. It endeavours to answer these questions, and in the light of

the analysis provided in the preceding chapters, which have been marked by multiplicity, it poses another: what is the effect of the multiple subjectivities and multiple GIS that emerge through its situated practice? This chapter is organised into two main sections. The first engages with these questions by drawing together themes which have emerged as significant in chapters three, four and five. It begins by exploring the tensions that arise from GIS being aligned with both objective, rational science and with wonder, spectacle and the magical. These contradictory discourses have emerged as pivotal to understanding both the practice of GIS and the embodiment of users and the machine. The affect of such ambivalence on space, gender and the figure of the cyborg will then be examined. The second main section explores the efficacy of the research design, outlining possible limitations, and concluding by suggesting possible directions for future research.

6.2 Between Magic and Science

The stories that emerge from the practice of GIS at SNH are compelling: intoxicating concoctions of mystery, intrigue and seduction, traversed by appeals to Western Science, truth and the rational, as well as marked by fear and distrust. They are stories that appear to unfold from the tensions created by interviewees' complex understandings of GIS, which emerge from their deployment of complementary and conflicting discourses that the practice of GIS both depends upon and contributes to. This process was most poignantly apparent to me as I took questions after presenting a paper on this research at the conference described in section 2.6. The paper, based on Chapter Three, outlined what processes enabled GIS to be constructed as credible. The audience comprised mostly of professional GIS practitioners, who were more familiar with technical issues or the logistics of implementation, and included amongst other SNH staff, my own interviewees. I was aware that the audience might be hostile to the account of GIS I was presenting, (and some were), but the 'difficult' question came from an academic geographer, whose interest in GIS was peripheral to his main research. He asked how one might protect the less powerful from the credibility of GIS? A member of the SNH GIS Project Board, sitting in the front

row, probably felt compelled to comment that the purpose of SNH adopting GIS was not to mislead with credible outputs, but, within the context of SNH's ethical environmental motives, to provide the staff with access to the best available information. Aware of the literature that has expressed concern about the ethics of GIS (Curry 1995a, Lake 1993, Pickles 1995a), and sympathetic to the rights of marginalised groups, I was also anxious to provide a response that was faithful to the accounts of the users I had interviewed, whose eyes were literally upon me.

Reflecting on this exchange, two figures emerge from these accounts: 'the deceiver', eager to exploit the credibility of the technology, exists alongside 'the conscientious', equally anxious to diligently adopt the best technologies to develop the soundest solution. Both are compelling, but neither exist, or rather both exist fleetingly, embodied only temporarily. As they emerge from the contradictory needs and fears of interviewees, these oppositional figures are sometimes expressed by the same person. Caught between the earnest question of the geographer and the sincere defence of the SNH Project Manager, the understandings of GIS articulated through the utterances of interviewees must be presented as complex. Of course, the user does recognise the utility of GIS outputs in persuading others, but equally users are not located beyond the seductive powers of the machine: they are just as captivated, even as they express their unease with the technology and as they articulate concerns that GIS might dominate analysis. They deploy the truth claims of Western Science, even as they recognise the limits of this strategy for explaining the messy world of lived experienced and intricate natural phenomenon. The understandings advanced by interviewees are marked by ambivalence.

This ambivalence is pivotal to the notion of GIS advanced in this thesis. The practice of GIS emerges from its reliance on both its credible performance as objective science and on its inexplicability as spectacle. GIS is not only credible, but incredible. The tensions between an appeal to the rational and the wonder associated with natural magic are discernible throughout the analysis of GIS advocated in this thesis, and structure the processes which embody both the machine and its users. Thus as user subjectivities and the embodied machine emerge from the practice of

GIS, they are formed in part by the rational. Users attempt to learn GIS on the basis that it is a useful tool, or reject it having judged that it is too time consuming or complex to learn. Similarly GIS is understood as a tool, which will facilitate effective working practice, whilst its role as an efficient spatial data management tool is situated within the discourse of Western Science, which enables it to be read as objective and logical.

Yet these reasoned perspectives exist in tension with that which lies beyond rational explanation. GIS is understood as simply inevitable, as interviewees uncritically adopt notions of progressive historical change. Instead of considering the utility of GIS for particular tasks, it is suggested that its adoption is intrinsically progressive. The expert, constructed as magician, is revered beyond the bounds which could be afforded by his or her status as competent user. The inept refutes the rational proposition that GIS skills can be acquired through choice or practice, and expertise is interpreted as a latent quality of particular bodies. Similarly this tension operates to produce the embodied GIS, where the notion that it is a tool co-exists with an understanding of it as sentient other, and even this ambivalence is layered with complexity. Its interpretation as tool enables users to negotiate their use of it, while this status is simultaneously disavowed to suggest it is something other. Concurrently it is produced as sentient other both through the material difference it makes to the process of data management and analysis and through magic. The user acknowledges that it constructs differing relationships between the analyst and their data, or that it repositions the actions of different human actors, providing them with different meanings and facilitating different products, but these material affects operate in tension with users' fascination for the mysterious innards of the black box.

The ambivalence that structures interviewees' understanding of GIS is in part articulated through the visual, where the visible contrasts with that which is positioned beyond view. So as GIS is performed as credible and persuasive, this understanding of it stems from both its utility as a method of realist representation that produces 'fancy products', and its ability to hide the process of analysis, enabling data to be presented as complete and authoritative. Similarly the body of

the machine acts as a focal point of wonder that users long to see. The machine that they invoke is corporeal, but this very wish to see it is based partly on the computational opacity of the GIS: it is impossible to view its functioning. The body of the magician is also spectacle, even though its expertise is latent rather than manifest. Users long for the proximity of the expert, even though this subjectivity is self-knowingly adopted by no-one. The tensions between the visible and the invisible, and natural magic and objective science act in tandem to produce multiple complex understandings of GIS and its users, but they are not directly mappable to each other. The visible cannot be equated with objective science, for it includes both 'objective' representation and spectacle. These layers of interpretation thus create understandings of GIS which are contradictory and complex, creating elaborate understandings of space, gender and identity.

The situated use of GIS at SNH produces and relies on a multitude of different spaces. As GIS was practised, at least three spaces were discernible: the 'real world' space from which data might be collected, the experiential space of the field, which is recognised by interviewees as qualitatively different from the complexity of the 'real world' and finally the GIS image itself. Interviewees recognise that their experience of the field, like the GIS image, is an abstraction of the complexity of the material realm itself. None of these spaces operate discretely, but are connected to each other so that one space might have material affects on another. Nor are they the only spaces discernible from the operation of this technology. As users interact with the system, producing both their own bodies and identities, as well as that of the machine, they (re)produce a space inside the machine and an exterior space in which users are excluded from the interiority of the machine. As discussed in Chapter Four, these spaces cannot be understood as binary, but operate in tandem, so that one structures understandings of the other, and it is possible for users to acknowledge and even occupy both simultaneously. These spaces interact complexly with the spaces which structure the practice of GIS. To be excluded from the machine does not thrust the user into the 'real world'; instead the user appears to be exiled into a limbo space. They are no longer interacting with

data, but often excluded and inactive. Similarly, the interiority of the machine does not necessarily imply the user is immersed in the GIS image. The interior is invoked to express feelings of being imprisoned or lost, as well as to intimate interaction with the data.

Pile (1994), in his commentary discussed in section 1.4, imagines a cyberspace where GIS, together with other networking technologies, enables the user to explore the world virtually. The act of exploration is envisaged as a journey, experienced by the cyber-body which travels a virtual terrain of information. The research presented here enables this fictional account to be assessed with reference to empirical data: the interviews demonstrated that users do envisage interacting with the GIS as a located bodily experience, that is, one which is performed in particular spaces. This is an exciting discovery, for while the notion that users exploit understandings of space and spatial metaphors in their interaction with various internet technologies is well established, the idea that the same concepts might function to mediate the use of GIS has not been advanced in the literature, nor empirically tested (Graham 1998, Lupton 1995). How these spaces interact with each other is beyond the scope of this thesis, for example, how users, who articulate their experience of interacting with GIS by invoking the interiority of the machine, relate this space to a virtual world composed of GIS data, is not clear from the evidence. The role of GIS technology in producing spaces will be reconsidered in the following section, which speculates on possible directions for future research.

This research sought to explore the effect of gender in the co-construction of users and GIS. In section 1.3, it was argued that computing technologies operate at various functional and symbolic levels, so that the impact of one technology has specific effects dependent on its situated implementation (Lupton 1995, Lie 1995, Sundin 1995a, Sundin 1995b, Hughes 1996). In terms of the practice of GIS, it was found that in this particular case study, gender was not a useful analytical category for assessing interviewees' utilisation of this technology. As discussed in section 3.4, although it was tempting to view the distinction between embodied experience of the 'real world' and the disembodied experience of the GIS image as predicated on

gender, there was no evidence in interviewees' accounts of their interactions with the technology to support this. The often ambivalent and complex understandings of GIS deployed by users produced an array of spaces which resisted simplistic gendered binary dualisms, and particularly in the context of a postmodern feminist framework, which seeks to resist essentialising, gender does not prove a fruitful category for understanding the practice of GIS at SNH.

Gender did however emerge as a significant factor in the development of user identities. As described in section 4.3, interviewees invoked gendered images to describe the interaction between their own feminised bodies and the masculine GIS. This process supports the literature of both feminism and STS, which has suggested that the body is both constructed through the use of technology and used to articulate relationships between the machine and user (Correll 1995, Haraway 1985, Haraway 1995, Lupton 1995, Marsden 1996, Morse 1994, Stone 1991a, 1991b). The cyborg emerges as both an important figure in these literatures and in the empirical findings of this research. The cyborg persona was key to understanding the emergence of user identities, where the feminised flesh was consumed by the masculinised machine, while the cyborg persona is equally important to understanding the embodied GIS: the sentience of the machine arises from the melding of human and technological agency. Within feminist literature on science and technology the cyborg has traditionally been celebrated as a symbol of post-gender feminist resistance (Haraway 1985, De Lauretis 1989, Wolmark 1993); however this research suggests that in this particular context, the cyborg does not represent a liberatory agenda. Rather it represents the domination of the fragile and feminised body by efficient technology, echoing instead the cyborg of Cyberpunk fiction (Ross 1991, Wahl 1993). This research therefore provides a cautionary note, particularly to Cyberfeminism, on the effects of technology on the (re)production of gender, and the use of Haraway's powerful mythic creature.

The use of GIS in SNH is marked by messy, contextual relations, which produce contradictory and ambivalent figures. The practice of GIS emerges as one dependent on discourses of rationality as well as magic. The subjectivities of

magician, apprentice and inept are unstable. Referring to no single user, these subjectivities are embodied knowingly by no-one, except in the most temporary sense, and the machine itself emerges as tool and toy and sentient other. Together these user subjectivities and the machine form a fluid cyborg persona, which is embodied through its iterative citation in discursive practice, and mobilises particular conceptions of gender and space. The understandings of interviewees are complex, contradictory and unstable, and their cumulative effect is to produce a complex, contradictory array of users and machines that enable GIS to function. They allow it to be multiply interpreted, holding together the contradictions and tensions between the discourses which construct the machine and its users. These diverse discourses enable GIS to support a multitude of practice, and to function as plausible and pervasive, even where the discourses that enable this fundamentally contradict one another. It has been argued that the subjectivity of magician does not refer to particular people, for no one can hope to be a magician. Perhaps this is not quite true, for although the magician is certainly not embodied in the user, nor in the GIS, perhaps the magician emerges in the amalgamation of both - the cyborg persona that emerges through the competent user and the complex technology. Certainly this cyborg is unstable, but invested with its authoritative consumption of the fragile feminised body, it is this figure in which the throws of masculinist control seem to be invested. A masculinist cyborg is possibly the real magician. The stumbling, confused and inept user can only ever hope to be the magician's apprentice.

6.3 Limitations and directions for future research

The research design implemented in this study has proved a successful one, yielding rich, contextual data, which has provided the basis for developing theoretical insights into the practice of GIS. It is however possible to identify the limitations of this design. Arguably many of the inadequacies of the strategy employed here arise from aspects of its structure which were purposefully adopted to ensure its ability to address other issues. Focusing on a single case study, for example, ensured that GIS in general, and its particular implementation in SNH, could be explored in depth; however this was necessarily at the expense of adopting a comparative approach,

which might have highlighted differences and similarities between different implementations, that would have useful in establishing which processes were typical or important. Similarly, given the focus on GIS, the applicability of this research to other computer technologies can only be inferred, though this research does constitute a contribution to knowledge about the use of computer applications, and could inform further research on other technologies.

SNH was considered to be an appropriate case study, as it enabled GIS to be studied before assumptions and practices around it were established in the organisation. It did however prove problematic to study an on-going implementation in its early stages. It was initially assumed that most users would have little experience of GIS prior to the training course, and that their degree of experience with GIS, having completed the course, would increase with time. None of these assumptions proved correct. The longitudinal approach had to be abandoned, and given that many interviewees were not adopting the technology at all, the research structure had to be modified and additional informants sought on the basis of their GIS skills. These problems should perhaps not be viewed as a failing of the research design. Research is a messy, contextual process: the researcher cannot be expected to be fully knowledgeable about the object of research prior to study, and modifications to the research design are often necessary, if not inevitable. The benefits of studying GIS as it was implemented therefore counterpoise the logistical difficulties that ensued.

A more fundamental problem inherent to this research is to whom it is of interest, and how to communicate it to different interest groups. This thesis has relevance to a range of academic fields, such as STS and Cyberfeminism, yet ironically, although it focuses on GIS, it is situated within a body of work which has largely been ignored by GIS researchers and practitioners. Debates concerning the social and cultural significance of GIS have been peripheral to GIS, and where GIS researchers and social theorists have engaged with each other, their discussions have been characterised by antagonism and misunderstandings (Openshaw 1991, 1992, Taylor and Overton 1991, Goodchild 1995, Pickles 1997). Situated within

postmodern feminist accounts of science and technology, this thesis relies on a theoretical framework which is remote to mainstream GIS research. This is reflected at a personal level: the data collected for this thesis could provide rich material on the social factors affecting GIS implementation, which would be of interest to the GIS research community; however such an analysis of the data collected lies outwith the remit of this project and my own interests. There is a need to present findings in such a way that preserves the complexity of the analysis suggested here, but is still acceptable to the GIS community and its academic forums.

This project prompts a number of possible directions for future research. As discussed above, research which examines the role of other technologies or alternative GIS implementations would provide a basis for comparison; however a substantive theme which has emerged from this research is the role of technology in the production of space. Despite the acknowledgement that actors and artefacts are (re)produced through performance, the 'stage' or spaces in which these relationships are negotiated has attracted less interest as an area of theoretical concern. The production of space is invoked here to refer to the processes by which the abstract notion of space is mobilised to construct relationships between the material and social objects that constitute 'realities'. This process is important because articulating these relationships gives meaning and structure to places, the objects that constitute them and to subjectivities. Spatialisation, as it is articulated through technologies, thus contributes to shared understandings of the world, affecting social processes. As discussed in chapters three, four and five, there is a tendency to invoke spatial metaphors to describe the relationships between the social and technology, particularly in terms of boundaries, interiors and exteriors, suggesting that psychological and geographical spaces traverse the natural and the technological. Yet while this has also been acknowledged in the literature, there is little theoretical analysis that explores how technologies produce space, and how this production is negotiated by and through the fluid artefacts that constitute it, as their interaction continuously reproduces each other (Lupton 1995, Graham 1998).

As Rose (1993) suggests, space and behaviour are mutually independent, so that while behaviour is influenced by our understanding of the spaces we (psychologically and materially) occupy, behaviour inevitably contributes to our understanding of space. Like all other social artefacts, space is not naively given, but constructed through our understanding of it, and as bodies and technologies are produced through the performance of multiple materialities, the 'stages' in which these performances are enacted are arguably equally diverse and complex. The construction of space by or through technology has attracted interest from geographers. These studies focus on two areas: technical representations of space and cyberspace. Representations of space have been recognised as social artefacts that are influenced by our ability to delineate them through technology. So, for example, it has been argued that images of the globe become powerful cultural symbols, which can be exploited to support the narrative of a seamless and connected world (Haraway 1985, Edwards 1995, Roberts and Schien 1995). Yet this focus on space is concerned with the effect of technical depictions of supposedly 'real' spaces, rather than the role of technology in creating spaces themselves.

Cyberspace has attracted interest from geographers as a potentially new place to explore, where the processes of social interaction are distinctively different. It has been argued that as a new space, where the rules of design, markets and legal frameworks are novel, it has the potential to fundamentally alter our conception of space itself, providing possibilities for the re-interpretation of material and social artefacts and structures (Batty 1993). This view has provoked concern that rather than prompting consideration of how 'real life' politics affect the virtual worlds we construct, the space we materially occupy will be ignored - a view which appears to reflect anxiety that the real is collapsing into the imaginary (Wolmark 1993, Stone 1991b). These studies of cyberspace appear to have two weaknesses: firstly, they have focused largely on the most visible of technically constructed spaces: those created by human interaction on the internet, such as Multi-User Domains (MUDs) and newsgroups, whilst ignoring (cyber)spaces created by other technologies, such as GIS. Secondly they rely implicitly on a binary opposition between constructed

technological spaces and the authentic 'real world' - a distinction between the natural and technological that has been discredited in relation to other socially constructed artefacts, notably the body. This is not to say that space does not have material effects, which limit the ability of discourse to interpret it, but merely insists that while space cannot exist outside our socially formed understanding of it, the distinction between socially constructed material and virtual spaces cannot be maintained. Cyberspaces exist not so much in parallel to the 'real world', but as an increasingly present aspect of it, and thus it becomes crucial to explore how diverse technologically produced spaces are constructed through dynamic social processes, and how these multiples spaces, produced and constituent of bodies, technologies and subjectivities, interact and construct each other. Clearly such a project would usefully develop the theory developed in this research.

6.4 Conclusion

This project endeavoured to explore interviewees' understandings of GIS, and to assess how the processes by which they negotiated each other co-constructed both the user and the technology. The GIS, interwoven and constitutive of systems of meaning and signification, emerges from this analysis as a boundary object, which gains only the appearance of stability through its iterative performance in the social. Formed through negotiations between the material practices of collectives of actors, its situated practice establishes an array of embodied subjectivities, which depend on a multitude of contradictory and competing discourses, as they are articulated through the corporeal. The body, like technology, becomes a medium through which the other is negotiated, and as the boundaries between them fall into dispute, bodies, technologies and subjectivities emerge as mutually unstable and regenerative, materialising only through social interaction. Fluid, open to dispute, user subjectivities and the GIS evolve from this process of social material inscription, and the sites, situations and narratives which they help to constitute.

Appendix One

- 1.1 The Uptake of GIS in SNH
- 1.2 Response by SNH
- 1.3 Implementation of GIS in SNH
- 1.4 Response by SNH

THE UPTAKE OF GIS IN SNH

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Executive Summary

- 1 This report is based on interviews with 32 SNH staff, and attempts to explain those factors which have influenced the uptake of GIS. Initial data suggests that many trained staff are not using the software.
- 2 Attitudes to GIS amongst SNH staff are very positive, suggesting that where uptake is restricted it is practical considerations which are most significant
- 3.1 Methods of selecting trainees has varied throughout the organisation, and some staff have elected to do the course through general interest, rather than because they can identify a clear need or application. Such staff were less likely to use GIS following the course.
- 3.2 Some staff undertook training in order to become familiar with the technology, rather than as a means of becoming a user themselves. This has contributed to restricted use amongst trained staff.
4. Some staff do not have a clear vision of how GIS will develop in SNH, and this makes it difficult for them to translate general enthusiasm into changes to their working practices.
- 4.1 The paper based report system is entrenched in SNH, and the efficiency with which it currently operates is to some extent a disincentive to using GIS.
- 4.2 Good Practice within the Mapping and Charting Office again provides a barrier to the uptake of map production, especially where ArcView cannot produce maps of a similar quality in terms of their cartographic design.
- 5.1 Daily pressures on time make it difficult for users to consolidate skills learnt on the course, particularly as initial experiences with the software are often frustrating and time consuming.
- 5.3 Access to appropriate hardware remains an issue.
- 5.4 Users require intensive support as they gain competency with GIS: the Local GIS Facility, providing personal communication, is presently a key source.
- 6.1 Internal group discussions are proposed as a means of developing context sensitive strategy: providing vision, and encouraging the development of GIS skills.
- 6.2 It is argued that a focus of resources on key users will generate the most productive development of GIS projects.
- 6.3 The development of support mechanisms, possibly centering on the personal style of 'face to face' contact currently preferred by staff, is suggested.
- 6.4 Improvements in access to hardware could be facilitated by ensuring that GIS PCs are allocated separate office space, to enable maximum access for all users.

1. Introduction

This reports on preliminary findings from interviews conducted with 32 SNH staff, constituting the first phase of this longitudinal study, and includes data collected from 16 informants who have completed the two day GIS training course. This interview material is drawn upon here to illustrate how GIS has been experienced within SNH, and to suggest those factors which have influenced its adoption into working practice. Of the 16 trained interviewees, 14 were randomly selected, while the remaining 2 were identified specifically for their high GIS use. This strategy was adopted partly to compensate for the low usage within the general sample - early analysis suggesting that approximately half of trained users have not used the software at all following the course, while a further, and possibly significant proportion have benefited from little or limited use. While such statistics arguably under-estimate the eventual adoption of GIS techniques, since some interviews were conducted shortly after training had occurred, it is clear from the data available that a high proportion of users have failed to utilise GIS several months after training has been completed. Thus initial data suggests that many trained staff are not using the software. In contrast to this, GIS has also been recognised within SNH as an important tool, and has been used to good effect to facilitate a number of projects, ranging from realising its potential for spatially referenced indexing to ease access to related hard copy data sets, through to high powered analysis to support consultative negotiations. This report attempts to outline some of those factors which are influencing this range of usage.

2. General Attitudes to GIS

Attitudes towards GIS amongst the vast majority of SNH staff are very positive. In analysis of the interview material phrases such as "flexible", "interesting", "sophisticated" and "useful" are consistently applied to GIS, while significantly many informants perceive GIS as an "exciting" and potentially "fun" approach to work. This appears to stem from the notion that GIS constitutes a tool which will ease data retrieval, speed repetitive or labour intensive tasks, and provide high quality products; promoting user satisfaction, and easing work load in what is presently an intensely pressurised environment. There is also a strong sense that GIS is synonymous with progress, and its adoption is often depicted as necessary or obvious, particularly given its potential to provide standardisation and an exact scientific methodology in a climate where justifiable and objective analysis for decisions concerning environmental management are deemed of increasing importance:

"[The developers are] certainly reacting a lot better to seeing it on a coloured map I think to sort of go through people's field notes on the birds, it does sound quite trivial in many ways. It says six birds were preening here, and ten birds were feeding there, if it's shown on a map then I think they find it more important, it doesn't sound quite as trivial to themthey certainly reacted better to seeing all the information we had set out on a map" [1.3].

Although most staff consider GIS will be beneficial, their understanding of it is not uncritical. The idea that even where data is imprecise, irregular or

incomplete, that "maps tend to be regarded as gospel" [2.10] is a concern for some staff, particularly as the improved presentation provided by computer software might ironically lend the data credence that it doesn't necessarily deserve. It has been argued that this could be a particular issue in relation to data collection within SNH, where the reliance on contractors, who may well not understand the intricacies of the GIS systems which will eventually store and analyse their primary material, could create problems, initiating disjunctures between data collection, storage and eventual use:

"I've seen things where a data set has been used for a purpose for which it wasn't really intended by the person that collected the data I think that's a danger with something like GIS, you begin to get a bit worried about some of the other data sets" [3.8].

However such problems are not envisaged as insurmountable, and staff are keen to emphasise that where data is carefully used, and considered in the context of appropriate "health warnings", GIS has great potential. A similarly careful approach is also characteristic of another key concern: the relationship between GIS and site visits. For although there is anxiety in some quarters that GIS will be used as a justification to further limit both field work and site visits, (because sufficient data is deemed to be already available on-line,) there is more general recognition that although GIS could never provide an adequate substitute for 'real life', it could be a useful tool to focus and prioritise work both in the field and in the office, by suggesting productive areas for consideration in both casework and research scenarios. Thus although staff are often (rightly) dismissive of the over-hyped, "all singing, all dancing" [4.8] image of GIS, they are eager to embrace it where it can be useful and productive: where it works for them.

In contrast to such positive attitudes, the notion of the technophobe remains an urban myth within SNH - countless interviewees suggesting that the uptake of new technologies is inhibited by this group of computer shy luddites, often described as lurking in senior management or amongst the older staff. This view was however not supported at all by the empirical data collected by these series of interviews, and though doubtless some staff still print out their email or draft by hand, the overwhelming response towards GIS is one of enthusiasm. This implies that it is rather more practical concerns that have inhibited the realisation of this optimism. Such factors will be considered in sections 3 to 5.

3. Selection and Expectations of GIS Trainees

3.1 Identifying Potential Candidates for training

A clear finding of this study was that the experience of potential trainees varied tremendously throughout the organisation, with the probability of individuals undertaking training being partially dependent on the attitudes of their respective line managers. In some areas the selection of appropriate staff had been a matter for intense consideration, while in others a more blanket approach to train everyone at particular grades was adopted, which didn't necessarily target staff who would be able to, or need to use GIS. A number of interviewees expressed the opinion that they had been trained as part of a

general strategy to introduce GIS to SNH, and that had places been more limited they would not have been selected for training. This appeared to promote the attitude that GIS was for them very much a subsidiary skill, which in general they did not appear to be using. Possibly the prevailing levels of enthusiasm for GIS did not act to the advantage of over-all policy in this instance, since the course appears to have attracted staff who responded through interest, while others who might have found it useful failed to secure a place. The following extract is reasonably typical:

"I must have been targeted because of my grade or something like that, I don't know really..... I was still interested in it, but I think that's just, I'm just a curious person if anything new's coming, whether it be just ordinary computer software or whether it's new databases or anything new, I'm interested anyway" [5.5].

This is arguably a particular issue in the light of the contractual insecurity experienced by a number of SNH employees, where the prospect of gaining a CV-able skill to aid both internal (and external!) job applications is particularly attractive. Another aspect of this problem appeared to be that where staff considered GIS to be an obvious and necessary step forward, they felt compelled to undertake training in order to keep abreast of progress for both their own, and their section's development. Although this is in some respects a very prudent and reasonable attitude, it tended to create a group of trainees who had little or no idea of how GIS might eventually prove useful. Such is perhaps indicative of failings in the implementation process leading up to training. Clearly in some areas this was a period of consultation and discussion about the potential benefits that GIS might bring, and the direction in which it ought to be developed in SNH. Such good practice was not however consistently applied, and clearly communication problems left staff at some levels unclear as to the over all purpose of the strategy:

"without wanting to be too disparaging I think they've managed it rather badly - they haven't communicated what's happening, what's it's aims and objectives were, and who would benefit" [6.10].

3.2 Expectations of Trainees

Prior expectations of course attendees to some extent account for restricted use of GIS amongst trained personnel, since some staff tended to view the course as an opportunity to learn about GIS: its potentials and limitations, rather than envisaging that they would become users themselves. This attitude stemmed largely from the notion that GIS was a particular skill which was not a priority for them to learn, but one which they needed to understand in order to supervise team members or to liaise with external agencies, including in the preparation of contracts. This attitude was not restricted to management, and in a working environment which often appears structured around asking colleagues to provide informal services, clearly some staff did not consider that their predicted limited use justified the time necessary to learn GIS, or to maintain developing skills:

"GIS is not something we would use day to day, and because it's got a different sort of range of terms and all the rest of it, I think the knowledge of how to use it will slip quite quickly I haven't used it for the last three or four weeks and it would be a case of having to have the manual in

front of me, just to remember which buttons do what again - I thought I would get from [the course, the ability to] understand what it can do. The people that are using it all the time, like [xxxxx] could maybe then say, oh yes, right, I'll see if I can find out that for you, sort of style, rather than using it myself" [1.6].

This attitude to training could be considered productive, as this has certainly enabled staff to initiate a number of projects, where the actual computing element has been passed to others, while it also provides a sound understanding of GIS more widely throughout the organisation. It is notable that many staff who adopted this position were actively involved in developing GIS projects, if not at a hands-on level.

4. The Role of GIS in SNH

Demonstrations of GIS provided by staff from the Local GIS Facility and other 'champion' users, in addition to the two day training course, have clearly created a degree of enthusiasm for the technique throughout the organisation. However, although some staff have a more detailed vision of how GIS might be specifically useful and integrated into SNH policy and practice, this is not the case for all employees, especially those working outwith major GIS projects. When questioned on SNH's vision for GIS, interviewees were able to talk with ease in general terms, for example, the automisation of current practice and improvements to accessing information, but many found it more difficult to translate these generalities into elements which might structure their own working practice. To some degree GIS was interpreted as a technology that was useful, but useful to other people: so Scientific Officers envisaged Area Officers using it to access data, and for Area Officers it was a tool for analysis up at Bonnington. Alternatively GIS sometimes became something that would only become useful at some indeterminate point in the future:

"if this project board as it exists could tell me why we'd all be sent on the course, I mean I can see to a certain extent why we've all been sent on the course, it's because digitising data is perhaps something that will, will gather momentum in the future" [7.8]

Confusion as to the future role of GIS in SNH could be viewed as a product of the implementation strategy employed, where the gradual introduction of this technology over a period of several years, has been contrasted with the 'Big Bang' training approach experienced by individuals. Many interviewees expressed the opinion that having had the two day intensive training course, there was no follow-up discussion, which made it difficult for them to capitalise on the perceived benefits:

"apart from the existence of this course, and my request to go on it, there's no obvious force there that's saying we can do this with GIS, we can do that with GIS, once you've been on the course we could, I don't know, sit down as a group or groups and discuss what we can use this application for, and what the whole point in the exercise was, there's nothing like that at the moment, there's no positive move as far as I'm aware that something like that will happen" [7.8]

4.1 The Paper System

If GIS is to be integrated into everyday practice it will however have to find a place amidst current structures: notably the paper based systems currently in use. Staff portray SNH as a tremendously data rich organisation, but are often critical of the mechanisms for maintaining data in a useful form. The haphazard methods of storage, the difficulty of exchanging information across administrative boundaries within SNH, and the reliance on the personal knowledge of staff were recurrent themes, while GIS was welcomed as a possible means of promoting standardised easy access. Indeed such applications, e.g. a planning database to spatially reference applications over time, often met with the most enthusiastic response from Area Officers. The paper based report system is however entrenched, and it is perhaps its efficiency which ironically inhibits the use of GIS. Most staff seem to rely on a limited range of data and reports for the vast majority of their work, and these are often accessible to them, partly because they are mostly located in bound reports by their desk, and partly because they are familiar with them. Or as one respondent suggests:

"we're still a paper based organisation and whilst that information is available in paper form, then people will probably tend to go to the paper files, unless it becomes easier and more useful to use GIS to get the same information - you've almost got to generate an environment where people have no option but to use GIS" [8.13]

Given the difficulties of gaining initial familiarity with ArcView, and the inconvenience of logging into the system, staff naturally opt to access data through more traditional methods, including spreadsheet and databases often accessible from their desktop. Although this is by no means inefficient, it does however mean that GIS is used less, in turn impacting the level of expertise that staff gain over time. Therefore when a task ideally suited to GIS presents itself, for example the overlay of different data sets, the difficulties in performing this can become insurmountable because the entire package is now unfamiliar and cumbersome. Resorting to tracing paper or a more expert colleague thus becomes the most attractive option. The problem here is that those functions which are potentially most useful, are often comparatively difficult to perform. This situation also has the effect of leading to duplication of systems, since both the digital and paper system have to be supported, in the same way that staff will presently send paper copies of email, as they are unable to rely that a colleague logs in regularly. This is obviously frustrating for those who are embracing the digital option:

"I was actually chatting to an Area Manager about this I was getting all excited and saying we're going to stick this on the GIS and send it all out to you boys and things - yeah he says, I'm never going to look at the GIS, just make sure you send a paper version of it too" [9.13].

4.3 Map Production

The efficiency of current working practice and its entrenched nature also recurs in map production, which is one of the key envisaged uses of GIS. Presently staff have a high level of satisfaction and confidence in the Mapping and Charting Office at Hope Terrace, who are portrayed as approachable and efficient: providing a quality, responsive service. A more cynical slant might

suggest that staff are merely eager to delegate map production, however this does not appear to be the case. Although a number of myths¹ proliferate concerning the maps office, there is a recognition that mapping is a particular skill, and that the map products are of a higher quality than those produced by an inexperienced user with the limited facilities provided by the ArcView software. These skills are particularly valued where precision for legal purposes, and/or excellent presentation are required. There does seem to be some confusion amongst SNH staff about what tasks can be appropriately accommodated through ArcView, suggesting that the ways in which the map office will complement map production throughout the organisation needs clarification. Further, training in the principles of cartographic design, perhaps contextualised within ArcView functionality, might be useful, especially for staff who intend to produce maps for external presentation.

5. Factors influencing the Uptake of GIS

In addition to some of the more general concerns discussed above, there are a number of specific issues which require some thought:

5.1 Consolidating User Expertise

Although the GIS strategy has always recognised that the two day training course was a first step in initiating user competency, and that long term support was required to enable the uptake of GIS, it seems clear that many trainees have not benefited from an environment conducive to consolidating their skills. Trained staff are very positive about the course, which they found intensive but enjoyable, however there is widespread agreement that time was needed to assimilate the information, and to practice. Some expressed the opinion that a longer course would have been more appropriate, especially if a problem solving element involving staff's own data had been incorporated. However a major issue for nearly all respondents was the difficulty, given the reactive nature of much of the work in SNH, in allocating time once having returned to the office. Expressing the desire to "play" with the system, interviewees exploited a vocabulary which contrasts neatly with the hectic terms they use to describe their work, and in an environment where "what you must do comes before what you can do, and what you would like to do come lasts," [10.1] it is hardly surprising that GIS is pushed aside.

Arguably the situation is exacerbated by the unrealistic expectations of staff about the ease in which they will learn GIS. Having undertaken the two day training course on the network, some staff were under the impression that ArcView would be as easy to use as email and word-processing software. One prospective candidate for training, expressing her disappointment on how difficult it appeared in a demonstration, added: "it is as involved as learning a word-processing package, and I think anybody who thinks differently would be

¹ among them that maps are hand drafted, that GIS can't produce maps like Integraph (even though Integraph is a GIS, and the Mapping and Charting Office do in fact use ArcView, albeit limitedly,) and finally, and most intriguingly, that the mapping staff are in fact in possession of software far simpler than ArcView which produces maps with ease at the press of a button.

quite over awed" [5.8]. Of course the reality is that using ArcView is far more complex than word-processing! Staff were mostly likely to use GIS after training where they could identify a clear and obtainable goal, which was directly useful to them. This is of course an ideal means of acquiring skills, however the pressures of deadlines, together with the expectation that they would be able to use the package competently after the course, led to some frustrating initial experiences:

"I've spent up nearly two days trying to convert my EXCEL files into distribution maps I've given up now, because it's two days of constant problems, and struggling I mean it's only stuff that I've learnt, or should have learnt in the course, I think I probably didn't learn enough details on the course, I hope that I'll be able to produce the distribution maps next year, but it's so time consuming, that I'm beginning to wonder" [11.6].

As such high expectations of GIS being flexible and efficient contrast sharply with people's experience of the technology, and although many realise that increasing expertise in GIS may result in eventual time savings, staff find it difficult to justify long term benefits in their hectic daily schedules. This is especially true where GIS is considered as an automating technology: the notion that the computer is merely performing a task already being undertaken by currently established methods. This view being prevalent, good intentions to use GIS fade, especially as many casework tasks are straight forward, such as viewing data, and easily satisfied by more traditional means. Thus the problems associated with gaining expertise are compounded from lack of use, creating a Catch 22 scenario.

5.2 Data Sets

The acquisition and maintenance of appropriate data sets is a familiar bone of contention, and unsurprisingly some staff have expressed the opinion that the limited range of data sets has inhibited their use of GIS. Given the small sample and the nature of this study, it is difficult to comment on this issue, though it is perhaps worth mentioning that the lack of small scale backdrops, particularly OS 1:10,000 and contour data are particular issues.

5.3 Access to Hardware

The provision of only one GIS PC per section or Area Office is a problem for many staff. Although most recognise that provision of a personal machine is unrealistic given their expected use, in pragmatic terms it makes using GIS for simple queries impractical. It is unrealistic for staff to leave their office, negotiate access to a machine often located on someone else's desk in another part of the building, to do anything other than a more complicated piece of work. This means that GIS is potentially less useful, and therefore less used, impacting the levels of expertise that staff may hope to gain. Access becomes a particular problem when the GIS PC is the personal computer of a colleague, or where staff feel others have higher priority access than them, for example where the machine was purchased in relation to a specific contract. Many beginning users feel they need a sustained period in order to become familiar with GIS, and to work through any problems that they have, and clearly feel

uncomfortable imposing on a colleague who may need to use the machine or their desk space for other tasks. As a result most users who attempted the system chose to undertake the work when they knew that their colleague was likely to be away for a period of time. This initiates another obstacle in terms of matching 'spare' time and access to the PC. Where the 'owner' of the GIS PC is developing expertise, it becomes particularly tempting for colleagues to avoid the difficulties of tackling the access issue by asking the 'expert' to do the task for them:

"I don't like going up to him and saying right, budge over, can I use your machine, and it's a case of people going up when he's not there or - people ask him to do it for them, because he's sitting there, and he's so into it anyway" [12.5].

5.4 User Support

Key GIS Users identify the Local GIS Facility as vital in developing their skills. It appears that this source of support is essential in the early stages of use, though as competence increases users become more independent. Concern has been expressed about what measures for support will be maintained in the future. This will be a more pressing issue for those who attempt to start using GIS at a later date.

Many users expressed the desire to have someone sitting next to them while they started to work through their GIS problems, and this was certainly the preferred form of support. The notes provided by the course were often not in sufficient detail to cover all aspects of the system which users needed, while manuals were often found to be too full of jargon and difficult to work through. The tutoring method seemed to be happening to some extent where certain more experienced users were easing colleagues through the learning process. To some degree the emergence of key users is creating this pattern of support, and it is perhaps a potential area of concern that such individuals might be overburdened with requests for support, and/or requests to perform tasks. Clearly however the flexibility of such an approach remains a benefit to such an informal support system.

6. Some Recommendations

Although this study is only at a preliminary stage, and the data gathered focuses on a very particular aspect of SNH's GIS policy: the user's perspective, it is however perhaps useful to outline some areas for consideration for development of future strategy:

6.1 Internal Group Discussions

Informal sessions amongst staff with similar responsibilities to discuss and develop the practical applications of GIS for SNH was considered a fruitful avenue by many interviewees. Such an activity would supplement and encourage the development of skills learnt in the training course, and if

envisaged as an on-going process of short, but regular meetings, would provide a contextualised and maturing environment which would complement the two days of intensive course undertaken in Edinburgh. Such an approach might also provide a window of opportunity, enabling staff to view the acquisition of GIS skills as a long term proposition, rather than as a technique which must produce time savings for each individual task attempted. These meetings could be facilitated by staff with some expertise in GIS, possibly someone within the team who has shown an aptitude for GIS, thereby encouraging 'championing' of the technology, and a degree of informal mentoring.

6.2 Focusing Resources on Key Users

Analysis of the interviews suggests that staff are most likely to develop skills in GIS either where they can identify a clear need, or where they have had previous involvement with GIS, either through substantial projects on-going in their working environment, or through previous extensive training. This created a situation where staff working in a GIS-rich area were sometimes more likely to have used ArcView prior to training, than trained staff who had no clear ideas on how GIS might be applied, irrespective of how enthusiastic this latter group might be. This tends to suggest that the most productive strategy would be to focus resources and discussions in those areas which might generate the most response, as indicated by current patterns of use, rather than to adopt a blanket approach. Obviously this would require a degree of balance in order not to stifle potential GIS projects.

6.3 User Support

This survey indicates that users require quite intense support in order to acquire sufficient skills to render them independent. The preferred method appears to be personal communication by telephone, or preferably through face to face contact. It has been suggested that a resident specialist in larger offices, notably Bonnington, would facilitate this process, though possibly the designation of key staff with responsibilities for support written into their job description might provide some compromise. Additionally further training in specific areas, such as cartographic design and statistical analysis might be appropriate for some staff, especially if it can related to the available functionality of ArcView.

6.4 Hardware Provision

Access to appropriate PCs is a problem which is perhaps only solvable with the passage of time, as machines are upgraded or replaced. However, since access is exacerbated when the GIS PC is someone's personal computer, being situated on their desk, an interim solution might be to move it into it's own working space where the demand for PCs per se, and office space allow.

1.2 Response From SNH

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Dear Sue

The Uptake of GIS in SNH

I am writing, on behalf of SNH's GIS Project Board, to thank you for the short paper you submitted via Stuart Gardner during May, and to give you some feedback on our reactions to it.

The Project Board, chaired by our Chief Scientist Professor Michael B Usher, particularly appreciated the concise and focussed form of your paper. It stands alongside two in-house studies, one being the evaluation carried out by Sally Bishop, the other being routine three month post-training evaluations carried out by our Training Section. All three show that take-up of the GIS facilities following training has been slow. As a result, we have changed the emphasis of the later stages of the LGF project to delay work on additional ArcView applications in favour of increased user support in the form of workshops held in our local offices. We expect that this will result in increasing use of LGF by the end of this year.

Your paper certainly captures the consensus among our target users as follows:

- GIS is an important new technology with a high potential value in SNH's work.
- The LGF training courses were of a very high quality, but compressed a large amount of information into the two days.
- It has proved difficult to find the time to follow up the training on return to the work environment, and support from managers has been ambivalent.
- As a result, users lack confidence in using the new facilities and tend to revert to established processes in their day to day work.
- A significant minority see GIS as 'too complicated' to deal with directly thus (in view of the preceding points) should be provided by specialists as a support service.

Where your paper is (understandably) less sure-footed is in grasping the thinking which led us to initiate the LGF project. The progress made to date should be seen in a wider context of introduction of information technology which is having a significant impact on working methods and organisation culture. This change, in turn, is driven by

disciplines imposed on all public bodies by Government to secure substantial efficiencies ("to do more with less"), in particular by limiting paybill costs. The business case used to initiate LGF is cast very much in these terms. The business case anticipates these benefits building up to full delivery over the next 3 years. Viewed from this perspective, the project is pretty much on track, and evaluation of the kind you have provided gives us valuable insights allowing modification of the project team's priorities.

The GIS Project Board asked me to respond to your recommendations in section 6 of the paper. We hope the planned local workshops will facilitate the group discussions you suggest in 6.1.

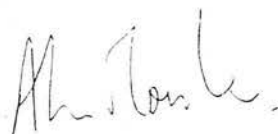
In 6.2 you highlight the role of 'key users'. We are keen to encourage this with the proviso that it is a stepping stone to wider adoption of the facilities, and does not lead to the development of GIS specialists delivering a service. We simply can't afford the latter approach, at least in our small and medium sized offices.

In 6.3 you consider the issue of user support. At present, we are keeping this under review. Although extensive remote support via helpdesk, bulletin board and the like is in place, the evidence is that users prefer a face-to-face approach. I think this is part of the culture change from local office autarky to effective use of the communications infrastructure now in place. It will be interesting to see whether users views on this change over the next year or so.

Finally, you note the difficulties arising from access to hardware. This, again, is part of a wider issue. All new PCs coming into SNH are capable of running LGF, and we are upgrading some existing machines with extra memory. However, the real constraint lies with our servers. Once there are more than a couple of active users per office it makes sense to put the software and data on the server so it can be shared. But this is frantically expensive, because the data volumes required were not taken into account in sizing our servers in the first place. The necessary upgrade cost can run to a 5-figure sum per machine. This is on the agenda, but will take time to work through.

I hope these comments are helpful to you, and encourage you to pass on further papers to us at an appropriate time in your study. In the meantime, please do not hesitate to keep in touch through Stuart Gardner.

Yours sincerely



Alan Mowle

cc Stuart Gardner
Delia Marriott

THE IMPLEMENTATION OF GIS IN SNH

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November, 1997

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Executive Summary

- 1 This reports on the second phase of this study, and is based on interviews with 19 GIS trained SNH staff. The focus is the on-going implementation of GIS in SNH, and the factors which have inhibited or promoted this process.
- 2 Staff continue to be positive about GIS, and find ArcView an appropriate and useful tool. Levels of anxiety amongst staff about possible negative effects of GIS are subsiding.
- 3.1 In this sample, approximately a quarter of staff had developed into key users, while another quarter were low level users. Less than half had not used GIS at all.
- 3.2 Key users are acting as 'champions' for GIS. They are providing support and services to others.
- 3.4 Non-users suggest they are not using GIS for a number of practical reasons, however users' reluctance is also based on the perception that GIS is a specialist skill, which is beyond their grasp.
- 4.1 Some staff are concerned that data acquisition has not been user driven, and that the drive to make high quantities of data available quickly has compromised quality.
- 4.2 Users would welcome more consultation on how data and metadata available on LGF is presented. They would especially like more complex views of data, for example, linking codes to text information.
- 4.4 Users find the customised ArcView environment useful, and would welcome further customisation.
- 4.5 Face to face contact continues to be the preferred method of support. A network of locally based technicians is advocated by many staff.
- 4.6 Hardware provision is currently meeting demand, however perceived hardware sparsity is arguably inhibiting potential users.
- 5.2 Key users have been pivotal to this implementation, and mechanisms to formalise their contribution may prove beneficial.
- 5.3 Efforts should be made to dispel the myth that ArcView is a specialised tool. Practical steps, such as customising the environment with the needs of the novice in mind, could contribute to this.
- 5.4 Users are often eager to be consulted about this implementation. Their expertise constitutes a valuable contribution. This could be facilitated through user forums.
- 5.5 The purchase of additional hardware now could be considered, as this will anticipate increasing demand, and possibly encourage further use.

1. Introduction

This report is concerned with the on the on-going implementation of GIS within SNH: focusing on the degree to which trained staff have adopted the technique into their working practices, and the factors which have inhibited or promoted this process. It relies on data collected from in-depth interviews conducted with 19 GIS trained staff between June and August, 1997, and constitutes the second phase of this longitudinal study. Four of these interviews were conducted with staff specifically selected for their high GIS use. The remaining staff in this group are a subset of the first phase of interviewees: selection for the second interview being random. This sample thus provides insights into the changing perceptions of GIS, and its strategic development within SNH. Additionally, interview material from the first phase has been drawn upon where additional analysis has made this appropriate. In section 2, attitudes towards GIS are examined, while in section 3 there is an attempt to differentiate types of user through their varying levels of use. In section 4 issues identified by staff as areas of concern are considered. Finally recommendations, that may address present problems, whilst capitalising on current good practice, will be suggested in section 5.

2. General Attitudes to GIS within SNH

The Uptake of GIS in SNH document, which was based on the first phase of interviews, reported that staff were overwhelmingly positive about GIS. In the second phase, this enthusiasm continues, and is if anything, more pronounced. Many individuals who were initially cautious, for example, in terms of GIS' predicted usefulness, or the effect that it would have in marginalising certain natural heritage concerns, are now embracing the technology, or at least thinking carefully about how it can be incorporated as a strategic tool in their work. This is obviously very encouraging, especially, as given the advanced stage of the implementation, these feelings are a response to hands on experience, rather than to any general rhetoric that might surround GIS.

ArcView appears to fulfill user requirements by combining appropriate levels of functionality with relative ease of use. Thus users who have developed expertise often report that it is easier to master than they envisaged. There is broad recognition that it is an efficient means of analysing data, and it is especially valued where external presentation, such as to developers or public enquiries is required. This is because the GIS provides a flexible method of dealing with large data sets that not only enables staff to formulate arguments, but also provides credible outputs, which can be easily communicated to others. Given the increasing use of GIS both internally and externally to SNH, staff are keen to develop their knowledge to better liaise with both colleagues and other bodies, while the notion that GIS is progressive and a system for the future is also pervasive:

"when I actually went on the two day course, and you see what you can do with it, all of a sudden all the other possibilities started opening up, and you see there's something which has such massive potential you can't help but gain an interest in it. I'm convinced that unless people are blind or just very, very stupid, they will see, and they will realise the potential".

3. Users Experiences of GIS

3.1 *Levels of GIS Usage amongst SNH staff*

Despite these general levels of enthusiasm, actual use of GIS continues to be restricted. In *The Uptake of GIS* it was reported that approximately half of trained staff had not used the software at all, while a further, and possibly significant proportion had benefited from little or limited use. Data gathered from second phase interviews confirms this trend. This can be examined more effectively by classifying trained staff into three categories:

- **Key users:** including previously highly skilled operators, and those who have gained significant expertise in ArcView from the course and through practicing. This group is competent and exploiting the system for a variety of applications. They are often providing formal and informal services to others.
- **Low level users:** tend to use the system in a limited way, possibly for producing maps, but mostly for accessing data. They often rely on the support provided by key users.
- **Non-users:** although this group has no hands on use, they often utilise their knowledge in discussion with colleagues, or request GIS services from key users.

Analysis of the randomly selected staff interviewed in the second round suggests that 46.7% were non-users, 26.7% were low level users and that 26.7% were key users. Although this sample is small, and therefore unlikely to be precise, it is never-the-less indicative of the levels of uptake, and suggests that staff continue to find it difficult to translate their enthusiasm into elements which might structure their own working practice. Discrete issues for each of these user groups tend to arise.

3.2 *Key Users*

Key users tend to be competent, and keen champions of GIS. Clearly it would be strategic to nurture this. Three factors seem to influence progression into this group. Firstly key users report initial enthusiasm for GIS. Secondly they were able to identify a task which was suited to GIS, and therefore able to learn in a productive working context. Thirdly, they were able to secure a concerted block of time and access to a GIS spec machine, to enable them to gain familiarity. Once skills had been gained, these users tended to continue using GIS, and to consolidate their skills. Although some key users had strong computing backgrounds, this was not a prerequisite.

This group tends to be very positive about providing support and services to other staff. This seems to be because they genuinely enjoy using GIS, and are eager to share their skill with others. Presently the volume of requests appears manageable. However as this role is not formally recognised, their contribution to supporting low level and non-users is obscured. Other staff often reflect on the difficulties that would arise if certain key users were transferred or left SNH, while the informal system of support obviously cannot work at all where no key

user is available in a team. This becomes a pressing issue where generally low levels of uptake leave some teams completely lacking in GIS expertise, despite the fact that in theory they may contain many trained users.

"I know it can be done, and I know it wouldn't take very long. All I would need is one GIS person's time, but other than communicating it by memo to Edinburgh, or travelling to Edinburgh and standing there and explaining it to someone and coming back, there is no way that I can get that done because [xxx] isn't a member of my team. He's under someone else's line management, and he has a completely different job description, and the person upstairs who knows most about GIS now works for advisory services and not my area".

In many respects it would also be useful to identify and formally recognise this group, as they are the most likely to benefit from further training, whilst they could provide a network for disseminating information and standardising practice. Currently key users recognise that their impromptu efforts to help may in fact create problems:

"I have had requests from people to produce maps of their particular area showing where all the European sites are. I mean that's not my role at all, and there is the problem that maps I've produced may not correspond with the ones that will be produced centrally. I know things are going to be altered, where as the official line will probably still be to include the larger area. So when ever I've produced any maps I've tried to make sure that's clear, and ensure that the maps aren't used externally".

3.3 Low Level Users

This group is often most concerned about the provision of informal and formal support. It seems likely that some of these users will develop greater expertise.

3.4 Non-Users

Non-users continue to constitute a substantial number of trained users, while arguably factors suggested in phase one interviews, and outlined in section 5 of the first report, persist in being problematic. When questioned as to why they hadn't used GIS, first and second round interviewees suggested the following reasons:

	frequency
I could never be as good as the 'expert'	17
I don't have the time to learn GIS	14
GIS is very complicated	6
GIS takes too much time, and isn't time saving	6
I lack the ability	4
I lack opportunity to practice, because essential data sets aren't available	4
I have difficulty getting access to hardware	1
GIS is scary	1
ArcView lacks sophistication	1

Such justifications embody a coherent argument against using the technology on the basis that GIS is perceived as a complicated software, which for staff working in a pressurised environment, is too intricate to learn, as the acquisition of skills cannot be justified on a time effective basis. This arises because the skills are highly specialised, and staff do not feel that the effort entailed in learning the system would be repaid by their anticipated use of it, particularly as they consider that the limited tasks which they need to do can be performed more effectively, and efficiently, by a 'proper' expert, or by themselves using more traditional methods. Therefore the 'efficiency, time saving' rhetoric associated with GIS, is not supported by their experience of it:

"it's quite a, a more, well slightly more specialist than - I think to be able to use that efficiently, you'd have to use it more regularly than we'll have the opportunity to do. So I don't see it having as big an impact as the rest of the IT system....."

"There's other people who will give it a go, but the feeling is that it's, it's quite a difficult thing to get to terms with, and the only way you're going to do it is if you've been on the training courses, and to start using it y'know, sort of quite regularly, and if you don't do that, then you'll soon forget how to use the system, and - and if there's nothing on it that you could use anyway, then y'know, you're probably gonna forget how to use it".

Although such arguments appear rationally grounded, these attitudes are complex. The emphasis on not being able to be as good as an expert is poorly founded, for the object of this strategy has not been to transform Area Officers into GIS experts, but rather to provide a basic grounding. It seems that part of the problem is that staff tend to construct an aura of mystique around GIS, contradicting this strategy's inherent assumption that the user can acquire skill through training and practice. In this scenario the ability to be good at GIS is not acquired, but mysteriously inherent, and people who feel they are not 'good' at computers, are at a loss to imagine how they ever might be. In this sense, being trained begins to be incidental:

"..... I don't think he's done the GIS course, although he's a bit of a computer whiz kid, so I'm sure he, he would pick it up pretty quickly if he wanted it."

Key users are therefore admired and appreciated for their skills, but their ability to lead by example, and to encourage other potential users, is seriously impaired. This is obviously the impression of one GIS technician on visiting another Office:

"they introduced her to me so she could have a word with somebody who had been trained in GIS, you almost got the feeling like she was the GIS person, this was the person who had experience of GIS, and almost - putting her on a pedestal, maybe a bit different or strange or something, - you did get the impression then that there was a feeling that GIS was something that was not for them to get involved with."

Such a view of gaining expertise requires careful consideration. These users are far from technophobic: they are often enthusiastic and quick to recognise the benefits of the technology. However the pervasive notion that GIS is a specialised skill which lies beyond the grasp of many potential users is a problem which inhibits its incorporation into mainstream use.

4 User Identified Concerns

The following section focuses on issues identified by the user group.

4.1 *Strategy and vision in the acquisition of data sets*

A number of users have expressed concern over the consistency between the acquisition of specific data sets and over arching strategy. Users perceive that the desire to get the project up and running has focused resources on making as the maximum number of data sets available in the shortest possible time. They argue that this tendency has prioritised quantity at the expense of quality, while not enough consideration has been given to how such data will eventually be useful. Frustrated that data acquisition does not appear to be user driven, staff can be critical, which is divisive. Key users, especially those who have identified data sets which they consider to have little utility, are often the most frustrated when data they consider to be essential is unavailable.

"There is no one taking an overview and there's no one asking the question how is this going to help us. They're all saying, what can we put on the GIS, so we can see what it looks like. They're all putting it on there, but a lot of them don't actually know other than sitting looking at it, what they're going to do with it once it's there, I think".

"A lot of the stuff that seems to be appearing on there are wonderful surveys which aren't needed".

4.2 *Available data and its quality*

It is recognised that there is a great deal of data available in LGF. Much of this is currently being used in applications, while staff are often excited by the new opportunities for overlay and analysis that this facility will provide for future use. Staff would welcome a greater degree of consultation in how the data available on LGF is presented. They are particularly keen to see more complex implementations, which, for example, link coded categories to text descriptions. Presently many of the data sets can only be properly understood in conjunction with written reports, and while this is cumbersome, it also generates concern that data will be misinterpreted.

Staff are also concerned about the quality of data and meta data on LGF, occasionally suggesting that the speed in which data has been acquired has compromised efforts to minimise error, and to provide adequate health warnings.

"Nobody from LGF came to me and asked me about the data at all. it won't have any health warnings in it, and you should need help to interpret it before you really come to any conclusions as to what it actually means. When that kind of thing happens, you have to think all they're bothered about is getting it on, cos if they were bothered about how good it was, then I would imagine they would come to the person who was responsible for putting it out".

Staff working in specialised fields, or local areas, tend to notice errors, because the data sets contradict their personal knowledge. This sometimes impacts their faith in the data, though most acknowledge the inevitability of some error.

Interestingly though, staff are generally unaware of any procedure for notifying errors.

Concerns about data quality extend beyond LGF data, and similar criticisms are often leveled at data inputted locally, or obtained from external sources, such as the Scottish Office. As for the LGF data, demand for centralised quality control and appropriate meta data, is considered of prime importance.

"we have included on there the Scottish Office boundaries, but it was like garbage. It has been put onto the system without any health warnings. I know this data is inaccurate, but if others don't have the same knowledge as I have, they could be coming up with rubbish. I don't know what quality control measures they put on the GIS stuff that they're doing, but for us to have accepted it blindly is irresponsible".

4.3 *Locating available data sets*

Although most users are aware of the LGF atlas, and had some understanding of current data availability, the majority of staff didn't really have a clear idea about what data they could expect to find on the system. Some users felt that a current list of all data sets available throughout the organisation, including those produced locally, would be useful. This would also enable GIS users to contact colleagues who had been involved in similar types of project.

4.4 *Customising the ArcView environment*

Users have high expectations of ArcView, and seem to envisage a very complex and highly customised environment:

"I mean what would be ideal you can delineate an area on a map, and then just say, give me the planning sort of tick list for that, and it would then run through, tell you all the designated sites, LNRs, SSSIs and it will run through the ancient woodland inventory, it will tell you whether there's any badger sets in there, it might throw up the Phase 1 data for that site, it will tell if there's Phase 2 studies, or whatever, so you, you could actually build in all these data sets, and basically set them up so at the press of a button it will run through every data set for a delineated area, churn out a standard set of information".

Users are exploiting present custom features, such as the map button, and although they can be amused or annoyed by some of the idiosyncrasies of the current environment, would welcome further customisation. Consultation to ascertain what non-experienced GIS users would find useful would therefore be productive.

4.5 *User Support*

As discussed above, users tend to value the assistance of local key users, who can offer personal contact. Users who have sought help through LGF express high levels of satisfaction, however there is a prevailing sense (often amongst non-users) that such support is distant, and may be fraught with communication problems. It is considered obviously easier to express a problem face to face. A network of locally based technicians, who could perform services and provide support, thus continues to be a popular ideal, however impractical that is recognised as being.

4.6 **Hardware**

Staff continue to report access problems to GIS spec machines, as outlined in 5.3 of *The Uptake of GIS*. Ironically however, non-users are the most likely to make this complaint. This suggests that where current hardware is sufficient for current levels of use, it is the perception of hardware sparsity that is the problem. This is possibly because such users feel awkward about 'playing' with the GIS, when a competent key user may be doing 'proper' work. This is problematic since a concerted block of time spent working through a problem, or 'playing' has been identified as a key stage in gaining expertise. All categories of user envisage that hardware provision will become problematic in the future as more staff use the facility.

Key and low level users tend to report that the machines are slow: often contrasting their experience in the office with the speed of data processing on the training course. the small screens also attract criticism, as do the printing facilities. This is a particular problem in outlying offices, where the quality of laser printers is considered to be especially poor. Users clearly find it frustrating to spend a lot of time producing a map when only the screen or a poor quality printer is available for output. They also report difficulties in obtaining plots from Edinburgh.

5.1 **Recommendations**

This section suggests possible measures for improving user's experience of GIS.

5.2 ***Concentrating on Key Users***

Although Key users have been pivotal to the integration of GIS in SNH, few mechanisms exist to monitor and manage this in a strategic or centralised manner. Their primary role arguably needs to be protected and encouraged. Incorporating GIS duties into job plans, for example, would allow this skill to be considered when renewing an individual's contract, whilst it would also identify a group most likely to benefit from further training. Additionally formalising existing practice would enable it to be controlled more centrally, promoting the standardisation of working practice.

5.3 ***Encouraging Uptake***

It is likely that as more data becomes available on the system, potential users will find it increasingly useful to gain expertise. Given some trained staff's apprehension, emphasising that GIS is not a specialised tool for computer technicians is important. This could be done quite explicitly, for example, directly in training or information sessions, or implicitly, for example, by providing a customised environment which meets the needs of the novice.

5.4 *Consultation with users*

Users are eager to contribute to this implementation, both in terms of data selection, data presentation, and the customisation of the ArcView environment. It seems prudent to exploit their expertise, and mechanisms to encourage communication to LGF may well prove productive. This could possibly be achieved through local user forums, perhaps facilitated by key users.

5.5 *Hardware*

Although hardware currently meets demand, perceived difficulties in access arguably inhibit uptake of GIS. Considering that increasing use in future will necessitate hardware purchases, it could be argued that further investment in hardware now, may well encourage new users. Clearly financial factors may preclude this.

1.4 Response From SNH

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Dear Sue

THE IMPLEMENTATION OF GIS IN SNH

I am writing, somewhat belatedly, on behalf of SNH's GIS Project Board, to thank you for the second paper reporting on your studies of our GIS developments (dated November 1997), and to offer some feedback on how we are using your material.

We are currently engaged in a review of our IS Strategy. The first Strategy was established in 1993 and has, essentially, run its course. The principal objectives, to establish a wide area network linking all our offices across Scotland, to install LANs at each site and to implement a series of corporate database applications, have been achieved. We are now looking to the future, preparing a second Strategy for the next 4 to 5 years.

For GIS, we established a subsidiary Strategy in 1994 which sought to secure a coordinated approach to GIS development across SNH and to make basic GIS facilities available in most of our offices, taking advantage of the network infrastructure described above. These aims have substantially been achieved, and we are reviewing them as part of the wider study.

Your reports complement and confirm our own assessments of the difficulties we have encountered in securing much wider use of GIS technology in support of our operational needs. I will focus on our response to your recommendations, as follows:

Concentrating on key users - We agree that more could be done to formalise the role of 'lead users', especially in our smaller offices. However, we do not want to take this too far. Discussion with novice users suggests that there is a delicate balance between providing sufficient support to encourage them to build up their skills and being so supportive that they simply hand over tasks to be completed for them by the 'expert'. We remain committed to securing a much wider distribution of basic GIS skills across our staff, so this tension is likely to remain with us.

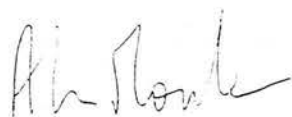
Encouraging uptake - we are continuing to run a series of local workshops which bring together users at a site with centrally-based GIS specialists. These sessions are led by local users who can describe their problems and priorities and get practical and on-the-spot assistance. In addition, these sessions feed back requirements for scripts which automate repetitive routine tasks, for example by presenting datasets in a particular way which facilitates their use in day to day work.

Consultation with users - We acknowledge this issue, and see it as part of a wider issue about (2-way) communication within SNH. As part of our initiative to secure 'Investors In People' recognition for SNH we have established an internal communications project. This will address the dissemination & understanding of the rationale for corporate developments (of which LGF is an example) and facilitate feedback to encourage better ownership of the priority choices which are made.

Hardware - This has been a continuing concern, albeit somewhat of a moving target. When we set out in 1995, our GIS-PC specification was a DX2-66, 16Mb RAM and 17" screen - somewhat ahead of our standard PC spec at the time (DX33, 8Mb). While these machines were capable of running ArcView (even under Win3.x), it became clear that machine configuration was critical. For example, when we upgraded our network to Novell 4.1.1, there was a severe degradation of ArcView performance which eventually was resolved by changing SmartDrive settings. However, our standard PC spec is now P200, 32Mb RAM which is more than capable of running ArcView and less sensitive to configuration details. I think this rapid development of the technology will solve the problem as older PCs are replaced. We aim to put new machines first into locations where LGF is used and then redeploy the older machines for less demanding purposes. With a turnover averaging comfortably more than 100 PCs per annum, this is quickly having a positive effect.

As you can see, development of our GIS capabilities continues and I hope you can see that your occasional reports have been extremely helpful to us in providing additional evidence on which to base our decisions. I hope your research is now drawing to a successful conclusion; Stuart Gardner has now moved on, but if you have any further commentary or analysis which you feel we might find useful please feel free to use me as a contact point.

Yours sincerely



Alan Mowie

Appendix Two

2.1 Memorandum sent by SNH contact to prospective interviewees

2.2 Letter sent to interviewees

2.1 Memorandum sent by SNH contact to prospective interviewees

RESEARCH AND ADVISORY SERVICES DIRECTORATE

**SCOTTISH
NATURAL
HERITAGE**



TO: Victims's name

FROM: Stuart Gardner

DATE: 06 December 1996

RE: Making effective use of GIS within SNH - Phd Interviews

CC: Alan Mowle

SNH is well on the way to implementing the SNH GIS strategy, with a substantial (and increasing) number of users trained, equipment in place and initial datasets available through the local GIS facility (LGF). We have been approached by Edinburgh University who have a Phd student, Sue Lilley working on *Socio-technical influences in the up-take of GIS technologies* i.e. what drives the uptake (or otherwise) of a facility like LGF.

The GIS Board has given approval for Sue to approach a number of SNH staff with regard to interviewing them about their experience with GIS. Sue is completely independent of SNH, although it is expected that the research will provide timely feedback to SNH in developing its approach to introducing GIS.

Sue has selected you from a list of staff who have already applied for GIS training or staff in the training target group (H and O grade) who have not asked for GIS training. The process will involve between 2 and 3 interviews, lasting around 40 minutes, between January and October 1997. Confidential interviews will take place at your office and will be recorded for Sue's use only.

Please let me know by 20th December if you will be willing to co-operate with this research.

Stuart Gardner

2.2 Letter sent to interviewees

This letter was sent, individually addressed, on headed notepaper.

6th January, 1997

Dear []

I understand that Stuart Gardener has already approached you regarding my interest in speaking to you about your views on GIS.

As Stuart has mentioned, this interview is part of my PhD research into the social and organisational factors that effect how GIS is used, and the impact it has on organisations. I am interviewing a range of staff within SNH, and am interested in discussing your experience of GIS with you over a period of time, as you develop GIS skills. I would be grateful if you could spare me the time for a maximum of three interviews, which would each last approximately 45 minutes. I would prefer to tape the interviews for my own records; however our conversation will be confidential and any feedback to SNH will be made anonymous.

Thank you very much for agreeing to take part in this research. I will telephone you within the next few days to arrange a convenient time for us to meet.

Yours sincerely,

Sue Lilley

Appendix Three

3.1 List of Codes

3.1 List of Codes

Code Name	Code Description
Access	to data and information, instant access, at your fingertips
Accuracy	accuracy of data and models, predictive methods of analysis
Automatic	nature of GIS, mystery, black boxes, tricks fascination and magic
Awkward	mundane, over-hyped, disappointment, a basic tool
complex and sophisticated	in terms of analysis, data management etc.
Efficiency	a convenient approach which is effective and speedy
Flexibility	ease of use, manipulatability etc.
Future	progress, rate of change, situating GIS in context of long time span, seen as modern, potential for the future, needing to keep up with change, to be modern, possibilities created
Inevitable	necessary, the 'snowball' effect, becoming everyday, seen as the only option, the sensible approach
not GIS' fault	a problem is identified, but other factors are blamed
Time	not enough time, time consuming/saving
Tool	as a tool for mapping, inventory etc.
Useful	
Philosophy	GIS is not a tool, but a philosophy
Physical	entering the software, cramming, feeling lost inside the computer, physical descriptions of reactions to GIS
Enthusiasm	excitement, interesting, impressed, loving computers
Expertise	aptitudes, lack of, being in the dark, genuine experts, seeking expert advice, experience, what is an expert
Fear	fear on part of the respondent or on part of others, technophobia
Jargon	confusing, getting your head round specialist words
Opportunity	viewing GIS as a challenge, opportunity to do so, opportunities to facilitate work
Play	having fun, fiddling or mucking around with the GIS
systems down	panic at loss of system, not being able to work without it, effect of crashes
Struggling	with GIS, learning, forgetting, becoming frustrated, needing help, finding it incomprehensible
Conservation	management strategies
Limitations	constraints imposed by GIS, technical, e.g. lack of software/data etc, limitations of approach
Consultative	management strategies, talking to people, co-operating, negotiating, role of GIS
data feel	relationship to data, intuition for, collecting your own data, owning your data
difference GIS makes	is the output the same, is GIS merely a different process, automating current tasks
Holism	taking a whole view, either through GIS or by rejecting the approach, getting the whole picture
natural heritage	relationship to and views of nature
Objective	justifiable methods, precision, factual, logical, exact scientific approach, objectivity, viable arguments
paper and pen	using traditional methods, needing paper back ups
"real life" interface	site visits, no substitute for 'real world', ground truth, knowing data through experience

Code Name (cont)	Code Description (cont.)
Standardisation	in approach, data etc. structured data, approach creating consistent results
working culture	accommodating GIS in culture of working practice, accepting GIS
Credibility	convincingness of GIS, faith in it and computers, blind faith, persuasiveness of results
data management	data sharing, data types, ordering etc.
Detail	degrees, necessity
Errors	all types, e.g. human, data, model, approach
health warnings	reliability and quality of data, how it should be presented to warn users of inaccuracies
Information	flows/pools
Maps	map reading, ease of use, difficulties in using, relating to 'real world', poor maps, potential of maps
Precision	
Presentation	slickness of the finished product, poor quality etc
See	looking, showing
Simplification	of data and real world
Understanding	spurious results, not understanding GIS, not knowing what goes on inside the computer
Visual	including patterns, pictures
personal knowledge	against data
Individuality	GIS as allowing individuality, or not, impersonal, being independent.

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